DOCUMENT RESUME

ED 376 060 SE 055 141

TITLE	Tropical Animal Tour Packet. Metro.
INSTITUTION	Metro Washington Park Zoo, Portland, OR. Educational Services Div.
PUB DATE	[94]
NOTE	95p.
AVAILABLE FROM	Educational Services Division, Washington Park Zoo, 4001 SW Canyon Rd., Portland, OR 97221.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	Animals; Botany; Conservation (Environment); Elementary Secondary Education; Endangered Species; Environmental Education; Field Trips; Geography; Habitats; Interdisciplinary Approach; Resource Units; Zoology; *Zoos
IDENTIFIERS	Environmental Awareness; Tropical Rain Forests; *Tropics

ABSTRACT

This packet is designed to assist teachers in creating a tropical animals lesson plan that centers around a visit to the zoo. A teacher packet is divided into eight parts: (1) goals and objectives; (2) what to expect at the zoo; (3) student activities (preparatory activities, on-site activities, and follow-up activities); (4) background information on the tropics; (5) a 43-word glossary; (6) a list of 16 Metro Washington Park Zoo county support services; (7) a list of 15 references; and (8) a teacher evaluation form for rating the packet. The on-site activities in the packet are in the form of "student data sheets" designed to aid students in gathering information ultimately to be used in a variety of associated follow-up activities. Levels of data sheets include level 2 data sheets more appropriate for grades 7 and above, level 1 data sheets more appropriate for students below grade 7, and multi-level activity sheets. Students are enagaged in the use of observation, record keeping, and data manipulation skills. (LZ)

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Metro Washington Park Zoo / Education Division

Tropical Animal Tour Packet

SE 055 191

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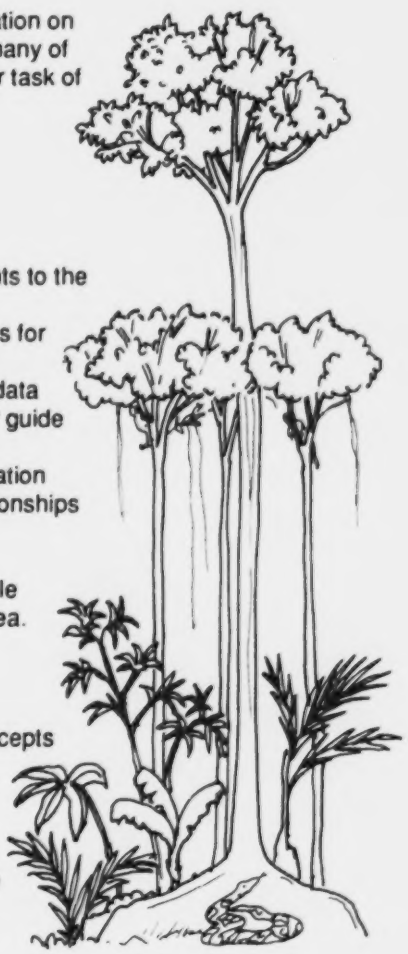
TEACHER PACKET FOR

TROPICAL ANIMALS

Nowhere in the the world is there more light, warmth and moisture than in the tropics. As a consequence, these lands are blanketed by the densest and richest collection of plants on earth. Forming one of the last uncharted frontiers, containing perhaps half of all the life on earth, much still unseen and unidentified, the jungle is a mystery filled with excitement, diversity and the magnificence of nature. Most jungles happen to be located in economically disadvantaged regions. Developing countries view these lands as resources to be exploited in the race towards economic independence. As a result, tropical forest habitat destruction is escalating at a rate of some 150,000 square kilometers per year. The plants and animals of the tropics exist in complex relationships with high levels of interdependence; when one disappears, the effect on others is immeasureable. Small wonder that three-fourths of the world's endangered species call the tropics their home.

This teacher packet is designed only to assist you, and it has more information on the tropics than you will probably need. We are certain that you will have many of your own innovative ideas, but perhaps this information will help make your task of class preparation an easier one.



This teacher packet on TROPICAL ANIMALS is divided into eight parts:

I. Goals and Objectives.

II. What to Expect at the Zoo.

III. Student Activities.

- A. Preparatory Activities: To introduce your students to the topic and prepare them for the Field Trip.
- B. On-site Activities: This section contains activities for students to do on the day of the visit.
- C. Follow-up Activities: These activities apply the data gathered at the zoo, recap the field trip and offer guide lines for further investigation.

IV. Background Information on the Tropics: To provide information about the tropics as an environment and the kinds of relationships that occur between its living organisms.

V. Glossary.

VI. County Support Services: A list of films and videos available through the Education Service Districts of the tri-county area.

VII. A Bibliography.

VIII. A Teacher Evaluation Form: For rating this packet.

The objectives and activities we have outlined are broad and deal with concepts rather than details. They are written to assist you and enrich the Zooday experience of your class.

Upon completion of your TROPICAL ANIMALS lesson, please take a few moments to complete the enclosed evaluation form. Our only gauge to the effectiveness of this program is your response. Send it to the Educational Services Division, Washington Park Zoo, 4001 SW Canyon Rd. Portland, Oregon 97221.

I. GOALS AND OBJECTIVES

GENERAL GOALS

1. To make students aware of the geographic regions of the world that are the tropics and the characteristics of these locations that lead to the unique features of the tropical environment.

2. To make students aware of the phenomenal diversity of plant and animal life that is found in the tropical regions of the world.

3. To promote student awareness of the fragile nature of the tropical environment and the impact of man's activities on the biological populations that live there.

4. To improve such student skills as observation, record keeping, and data manipulation.

BEHAVIORAL OBJECTIVES

1. Students will be able to locate on a map those regions of the world that are considered to be tropical.

2. Students will be able to identify the basic characteristics typical of the tropical environment.

3. Students will be able to demonstrate some similarities of animal lives and lifestyles which exist from one tropical region of the world to another.

4. Students will be able to identify several tropical animals and explain one or two special ways each is adapted to its environment.

5. Students will be able to list reasons for the decrease of healthy tropical habitat and demonstrate the relationship this has to the survival capacity of those biological organisms living there.

6. Students will be able to project the effect of the on going destruction of tropical forests to its ultimate impact on existing biological systems.

II. WHAT TO EXPECT AT THE ZOO

The zoo is a rich and stumulating environment in which students can easily be distracted. Reasearch in science museums indicates that children are often overwhelmed by unfamiliar sights and sounds as well as what they preceive to be "freedom" from a typical classroom setting. When this happens, their attention becomes focused on the novelty of the experience and little learning about the actual exhibits takes place.

To help your students have an enjoyable, productive visit to the zoo and to make your job easier, we suggest you discuss the following with your students.

1. THE PHYSICAL ENVIRONMENT

The zoo is often crowded with other classes and groups of children that may be active and noisy. Many of the indoor exhibits are darker and cooler then those in outdoor areas. Remind students that indoors noise tends to echo. Each exhibit has many stimulating pictures, signs and interactive displays. Discuss with your students the importance of the information given in these, emphasizing that they sould be looking for and reading them. The games at the exhibits are very popular with visitors and are best utilized by small groups. Most live animal viewing areas are adequate for large groups, but small spots such as den entrances and aquariums are utilized best by one to six students at a time.

2. STUDENT ACCOUNTABILITY

Speak with your students about appropriate behavior. Although most students are aware of how to behave, they sometimes forget in the excitement. The on-site activities of the packet are organized around students collecing blocks of data to be used at a future date. For these to be successful, students must be alert, prepared and stay on task. Discuss with them what kinds of information they are looking for and where to find it [the specifics of this are outlined for you in individual "teacher's guides" that accompany the data sheets]. Remind students that they will have a lot to do, and won't complete what is required if they play around. Remember student accomplishment is directly related to what is expected of them. Keep your expectations high.

Involve your chaperones. The zoo requires a chaperone per five students. You may wish to have your chaperones read the background information on the nature of the tropical environment and its zoological diversity, as well as this sheet so they also know what to expect. Providing your chaperones with some hints on asking students leading questions to focus their observations on the animals and their characteristics may also prove helpful.

III. STUDENT ACTIVITIES

PREPARATORY ACTIVITIES

In the classroom, the tropics can be dealt with as an interdisciplinary topic involving geography, social studies, language arts, as well as a LOT of science. To benefit from a Zoo visit that emphasizes this environment, it is suggested that your students have some familiarity with the geographical locations of the tropics as well as their unique environmental features.

1. GEOGRAPHY OF THE TROPICS

Students need to be familiar with where on the map the tropics are located and their relationship to the Equator and Tropics of Cancer and Capicorn. This can be done by using a globe or large world map in conjunction with the "Where in the World Are the Tropics?"

activity provided with this packet. The map activity can be used in a variety of ways depending on the map skills and general level of your students. See the individual teacher's guide for "Where In The World Are The Tropics?" for ideas.

2. TROPICAL HABITATS

Student awareness of the vertical nature of the rain forest [see teacher supplemental information] can be accomplished in a variety of ways:

1. Through class discussion, student research, and/or audio-visual aids, provide students with the basic "feel" of the jungle. Have students write a story from an explorer's point of view on their first day in the jungle.

2. Have students make a poster or collage showing typical rain forest structure and relationships. This can be done using student drawings or illustrations and photographs from magazines. Animal locations may be incorporated if desired.

3. Use the activity "Rain Forest Homes" [included in this packet] as a review to your introduction. This stresses the structure of forest and places emphasis on some of the ways animals have adapted to living at different levels.

4. Show a film or video on the tropics. County Educational Service Districts have a variety of these available for the classroom teachers use [see Support Services [Section VI] for a listing of the films and videos available in the tri-county area].

3. ANIMALS OF THE TROPICS

Observation, organization, data collecting, and data manipulation are essential skills. A well organized block of information can be used to enhance your classroom activities in geography, conservation, ecology and animal groups long after your field trip is over, or to support those concepts covered earlier in the year. The on-site Zooday activities provided by this packet requires students to use these skills in varying degrees. Having students make and keep a record of what they see makes observation more meaningful, accentuates important points and helps keep students on task.

The on-site activities in this packet are in the form of "student data sheets" designed to aid students in gathering information ultimately to be used in a variety of associated follow-up activities. Two levels of "student data sheets" are included for students at different stages of learning. Both levels cover the same basic groups of animals on exhibit at the Washington Park Zoo and introduce the same concepts. In general, Level 2 data sheets are more appropriate for grades 7 and above, while Level 1 data sheets are more appropriate for students below grade 7. However, only you can determine which sheets are best suited for the ability range in your class. Before your zoo field trip you need to:

1. Introduce students to the necessity of accurate observations and record keeping.

2. Discuss the importance of data charts, deciding before you start what you are looking for and going to record [the individual "Teacher's Guides to Student Data Sheets" gives specific information concerning this].

ON-SITE ZOO ACTIVITIES

Although there are several student data sheets for each level, the central student data sheet of this packet is "Mammals of the Tropics" with Level 1 and Level 2 versions. "Mammals of the Tropics" leads students through the majority of mammals at the Washington Park Zoo considered to be rain forest inhabitants. A necessary degree of flexability has been build into these data sheets due to the dynamic nature of zoo exhibits. Animals are constantly being added to and removed from the collection. To accomodate this there is a space for students to check if a listed animal is not present and extra lines to add animals present but not on the list. Level 2 is aimed at older students and requires more specific information. The amount of time required to complete "Mammals of the Tropics" will vary from group to group, but on the average, it should take from one to one and one-half hours to complete. In addition to "Mammals of the Tropics," there are other student data sheets for each level as follows:

LEVEL 1

"Group Living" - This student data sheet covers two dissimilar species of animals shows social behavior with other membeçs of their group. It takes approximately 30 minutes to complete.
"Living Other Places" - This student data sheet covers the Tundra and Cascades exhibits and gives students information necessary to compare these two environments to the rain forest. It takes approximately 40 minutes to complete.

LEVEL 2

"Monkey Business" - This student data sheet gives students practice in observing primate group behavior. It takes about 30 minutes to complete.
"The Other Extreme" - This data sheet covers the Tundra exhibit and gives students the information necessary to compare the tundra environment to the rain forest environment. It takes approximately 35 minutes to complete.
"The "Here" of Here and There" - This data sheet covers the Cascade Wetlands exhibit and gives students the information necessary to compare the food relationships seen in the Cascades to those seen in the rain forest. It takes approximately 35 minutes to complete.

FOLLOW-UP ACTIVITIES

The chart below shows the follow-up activities included in this packet and which student data sheet applies to each.

	Activity	Data Sheet Required
LEVEL 1	How Am I Different?	Mammals of the Tropics
	Group Living	Group Living
	It's A Rain Forest	Mammals of the Tropics
	?A Puzzle?	Mammals of the Tropics
	Everyone Lives Somewhere	Mammals of the Tropics Living Other Places
	Living Here or There	Mammals of the Tropics Living Other Places
	The Problem on Madagascar	None
LEVEL 2	Living Around the World	Mammals of the Tropics
	Two Extremes	Mammals of the Tropics The Other Extreme
	Rain Forest Living	Mammals of the Tropics
	Monkey Business	Monkey Business
	Here and There	The "Here" of Here and There Mammals of the Tropics
	What is Happening on Madagascar	None

The individual "Teacher's Guides" for each activity indicates:

1. Student objectives for the activity.
2. Directions for implementation.
3. Ideas for expansion.

IV. INFORMATION ON THE TROPICS

The information in this section of the "Teacher's Packet" is designed to give the classroom teacher adequate background to introduce the tropics as a unique biological system. It describes the environment in general terms, using specific illustrations, examples, and interpretations as interest stimulators.

GEOGRAPHIC REGIONS OF THE WORLD

The portions of the world considered tropical are three blocks of uncontinuous land surrounding the equator of the earth that lie between the Tropics of Cancer and Capricorn [latitudes where above and below the sun is never directly overhead]. The central region of these typically tropical land areas is considered to be a tropical rain forest. Surrounding its outer edges are the more subtropical monsoon regions, also covered by forests but of a slightly different nature. The total world land mass that falls into this environmental category is approximately one twelfth; however, it makes up one half of the world's great forests.

1. **The Americas**
Three regions of tropical rain forest are found in the Americas, with the Amazon being the largest rain forest in the world.

1. Choco Forest ranges along the northwest coast of South America between the Pacific Ocean and the Andes foothills in Columbia. This forest reaches into Ecuador to the south and Panama to the north. On the Caribbean side it extends through the American isthmus to southern Mexico.

2. Brazilian-Atlantic Forest extends along the Atlantic Coastal Mountains in Brazil.

3. Amazon-Orinoco Rain Forest has its major land mass in Brazil with its western side extending into Bolvia, Peru, Ecuador and Columbia; the northern border of the Orinoco Basin is in Venezuela; and its north eastern portion extends into Guyana, Surinam and French Guiana. On the Caribbean side it ranges through the islands that make up the West Indies.

2. **Africa**
African tropical forests exist in three major areas, two inland in Central and West Africa and one on islands. Isolated patches exist through East Africa on the shores of Lake Nyasa, in northern Zimbabwe [Rhodesia] and in the mountain regions of Kenya.

1. West Africa extends as fingers from the Gambia River to the Sierra Leone, then becomes an unbroken blanket to the Volta River. At this point it breaks up to re-form at the Mountains of the Moon and crosses the Congo to the west of Lake Tanganyika.

2. Central Africa covers the central basin of the Congo in Zaire.

3. Island Forests exist on Madagascar and the Comoros.

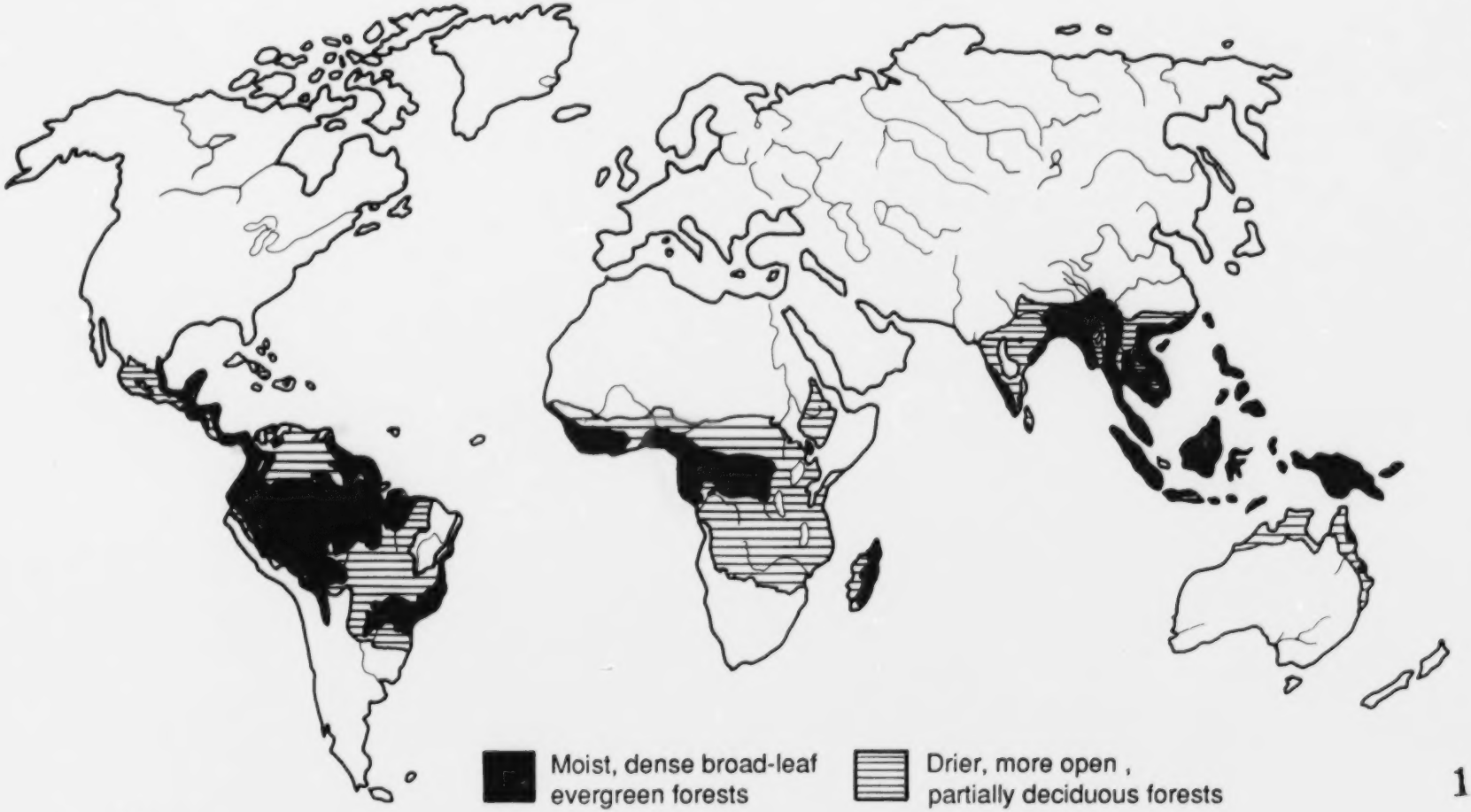
3. **Asian**
The Asian rain forests are characterized by not having great land mass. The majority are on the islands that range from the southeast Asian coast to Australia. Those present on the continent of Asia itself are all within a couple hundred miles of the coast; the largest of these is in Burma.

1. Indian starts on the west coast of India, extends to the Pacific and re-forms on the island of Sri Lanka [Ceylon].

2. Burmese begins at the Bay of Bengal in Burma and extends through Nepal to the southeast slopes of the Himalayas; it includes the monsoon forests of Thailand, Vietnam, Cambodia, Laos, and the Malay Peninsula.

3. Australasian begins on New Guinea and spreads over the Indonesian Archipelago [13,667 islands], the Solomons, the Hebrides and along a narrow strip of Australia.

Distribution of Tropical Forests



NATURE OF THE ENVIRONMENT

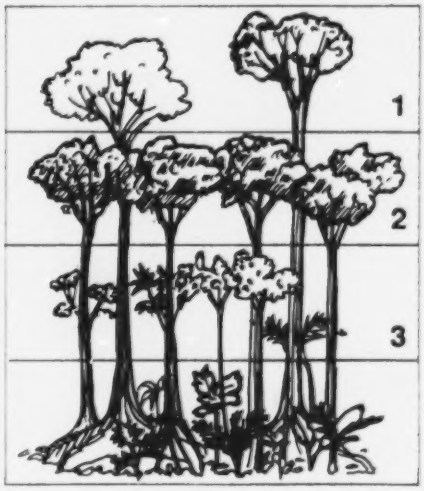
The tropical rain and monsoon forests, more commonly referred to as jungles, evoke images of hot, humid, impenetrable, dangerous places. The word "jungle," derived from "*jangala*," was, in fact, originally used by the British in India to mean any impenetrable vegetation. This image of the jungle actually only pertains to those areas on its perimeter, along rivers or clearings where light is able to penetrate to the forest floor. The band of thick vegetation is generally only a few hundred yards wide and once broken through, the forest floor is open. Characteristic of these jungles is the exceptionally large number of **different** plants and animals that are found there in contrast to the more temperate regions of the world.

There are many different kinds of rain forests with the most complex and diverse being at lower elevations. Basically, however, the forests can be described in vertical layers with different habitats being formed at different levels. The mature forest has three recognized layers:

1. THE EMERGENT LAYER - formed by the forest giants. These solitary individuals emerge from the thick layer of foliage directly beneath, rising well above the remaining trees.

2. THE CANOPY LAYER - composed of flat-crowned trees standing 18-25 meters [60-80 feet] tall, whose foliage may range from 6-7 meters [18-21 feet] deep. They form a dense continuous cover that is often interwoven with large and woody climbing plants.

3. THE UNDERSTORY - composed of small [sometimes young] trees [generally not more then 3 meters [10 feet] tall] and shrubs with elongated crowns and large leaves.



THE CLIMATE

In the tropics the mean [average] daily temperature remains quite constant, with more variation from day to night then from day to day. Day length varies approximately one hour seasonally. This is caused by the fact that the sun's rays are more evenly distributed here than any other place on earth. Tropical temperatures are also strongly influenced by the oceans [three-fourths of the entire tropical zone is covered by water] and the ground's staying warmer than the air.

Precipitation is higher than other places on earth, ranging up to an extreme of 1000 cm [400 inches] per year, the majority of which falls as short heavy showers in the afternoons. Variations in rainfall from month to month mean little as long as there is no prolonged dry season. Near the equator the sun may be behind clouds more than half the day, which has been interpreted to mean that although air temperatures are high, the total solar radiation may be considerably less than would be typically seen in temperate regions. Humidity also remains high [warm air can hold more moisture than cold], sometimes at a saturation point for days, and rarely drops below 95% in the understory, making it feel warmer than it actually is.

SOILS

Rain forests throughout the world have several common soil characteristics which strongly influence the nature of this environment.

1. These soils are relatively poor in plant nutrients due to the excessive rainfall and run off which carries available nutrients into the rivers. Nutrients that remain go into solution rapidly, and the vegetation takes what there is before it has a chance to become a part of the soil.

2. These soils have comparatively small amounts of humus, particularly when one considers the amount of vegetation they support. The climate is ideal for decomposition, and organic materials break down quickly [fallen leaves will disappear in a few days]. Mineral components dissolve immediately into the few inches of top soil and are promptly picked up by the plants.

3. Rain forest soils are acidic, once again due to the excessive amounts of water "leaching" the soil. Drainage takes soluable salts out of original rocks. Even in regions of limestone, the lime is carried away before it can have an alkaline effect on the soil. The end result is that acid-loving plants have a big advantage.

4. These soils "weather" almost entirely by chemical processes. Lack of variation in temperature and other physical climate changes means that ground water acids are the only way rock is converted to soil. Chemical weathering is a relatively slow process.

5. These soils are shallow because water gives them little time to accumulate. Erosion is common particularly in hilly areas, with streams and rivers carrying much of the top soil away. For example, the Amazon carries 130 times more solid matter then comparable rivers, such as the Rhine, with silt being visible for over a hundred miles out to sea from its mouth.

BOTANTICAL CHARACTER

Diversity is a key word when describing the plants of the tropical regions of the world. The total bulk of life supported per square yard is greater than seen in any other environment, with several hundred different types of plants being present on a few acres. No one type of plant dominates. In fact, it may take considerable time and effort even to find two individuals that belong to the same species in the same area; *"common species are rare and rare species common"* [Forsythe and Miyata].

The tropics are regions of woody plants. Soft stemmed herbaceous types of plants play only a minor role, with not only fewer individuals being present, but also fewer species being represented. In some cases, plants which in temperate climates are small and soft, have become large and woody, an example being the tree violets [members of the pansy family] of South America which grow to 10 meters [30 feet tall]. Part of the reason for this botanical character is a continuous growing season with little change in temperature and moisture throughout the year.

Each level of the forest has its own environmental criteria. The plants that occupy these levels have developed specific, sometimes unusual adaptations that allow them to be successful. These plants are the framework on which the forest rests. They provide the habitats and microhabitats, as well as the energy, on which all the animal life depends.

THE EMERGENT LAYER

The individual solitary trees that form this layer average from 50 to 70 meters [150-200 feet] in height, tending to be taller in more seasonal regions with 7 meter [21 foot] diameters. The environment they occupy is one of higher temperatures, less humidity, more intense radiation, and stronger winds than the rest of the forest. Consequently, they exhibit a number of adaptations to these environmental circumstances.

Typically their trunks are straight and smooth without branching until they break through the canopy, sometimes 30 meters [90 feet] above the forest floor. Their root system is shallow due to the lack of soil, so to obtain stability, they usually have heavy buttresses [extending as far as 3 meters [15 feet] up the trunk] around the base. The trunk of a mature specimen is often hollow. This hollowness is in part due to insect activity that starts when the tree is young; however, it is felt that some trees actually rot their own cores to deliberately recycle their own nutrients. An added benefit to being hollow is the source of nutrients from guano produced by animals that take up residence in these trees.

These trees are evergreen but are not conifers [needled]. Their leaves are small and covered with a thick, waxy coating which helps to reduce water loss through evaporation. Their flowers are generally wind-pollinated, and seeds are often winged to give them greater dispersal potential.

THE CANOPY

The canopy forms the backbone of the rain forest. Viewed from above, it appears as a continuous mass of vegetation. It is formed by straight-trunked trees that do not branch until they crown 20 to 25 meters [60-80 feet] from the forest floor. The larger specimens are generally buttressed for support at their bases, and smaller varieties often have stilt roots growing from their trunks pyramid-style. Huge horizontal branches form the crown. The leaves, even of different species, are surprisingly consistent in shape and size, being smooth and shiny on both sides, with prominent pointed tips on their ends. The smooth shiny surfaces and 'drip tips' keep water from collecting on the flat leaf surface and thus discourage moss and algae from growing, which would smother the tree.

The trees of the canopy are bound together by vines. These vines may be woody climbers or soft creepers. By definition, vines are not capable of vertically supporting themselves. Most are rooted in the ground, but some thrive on accumulations of debris high in the trees. Others obtain their moisture from water running down the tree trunks, while still others hang out fleshy roots and obtain moisture from the air.

The canopy supports different types of aerial plants. Most numerous, with some 28,000 species having been identified, are the epiphytes [pronounced "eppy-fites"]. They use the canopy trees only as a physical support system, receiving all their moisture and nutrients from the air. Up to 100 different species may be found growing on a single tree, each with its favored place. The more shade loving plants, such as the orchids, grow in the lower regions of the canopy while those requiring more sun grow toward the top. Epiphytes show many adaptations to tree-top living where a major problem they surprisingly encounter is drought. Leaves are often reduced in size and have waxy coatings. Some are capable of shutting off their metabolism when dry, while the leaves of others, such as the bromeliads, are arranged in such a way that they actually form small water tanks that may hold up to eight liters [a

gallon] of water. The weight of epiphytes can present problems for canopy trees, causing branches to break. These trees, in turn, have developed ways of controlling this growth. Some trees have flakey bark which can be sloughed off along with all that grows on it, while others impregnate their bark with toxic chemicals that prevent seed germination. Other trees take advantage of the epiphytes growing on them by forming mats of arboreal roots that can take advantage of trapped water and animal debris. It has been estimated that at least half of the nutrients in the canopy may be locked up by epiphytes so any tree with structures to tap this source has a survival advantage.

THE UNDERSTORY

The limiting factor of the understory is lack of light. Plants growing here must be capable of living in deep, green-tinged shade. Light in this region is reflected from the vegetation above. The understory may be populated with seedling canopy trees as well as dwarf trees and shrubs. Plants that mature in the understory have large flat leaves capable of using all the available light.

A second problem for understory plants is lack of air movement. These plants must all rely on animals as pollinators. With the gloom making flowers hard to see, some solve this with bright colors while others bloom only at night with white strongly-scented blossoms. Scent, in this case, acting as an attractant to pollinating moths. Flowers are often on trunks or lower branches, making them more obvious as well as giving adequate support to fruits and seeds which have large food reserves. Many understory plants synchronize blooming time, with all members of the species flowering within a matter of days, improving chances of cross-pollination; others may flower only at long intervals when conditions are ideal.

THE FOREST FLOOR

The dark forest floor is a hostile habitat for chlorophyll-containing plants dependent on light for photosynthetic activity. As a result, few green plants grow there. Saprophytic organisms [those using dead, decaying organic matter as a nutrient source] such as fungi are present. Their inconspicuous thread-like bodies, requiring high levels of moisture but no light, rapidly decompose the rain of debris from above.

Many saprophytes rely on animals to disperse their spores [reproductive products] as air movement here is not adequate to accomplish this. They use spectacular fruiting bodies, brightly colored with varied shapes, and in some cases emit attractant odors as a lure.

ZOOLOGICAL DIVERSITY

The jungle provides unlimited habitat for animals, especially ones such as the insects. Thick foliage, continual flowering and fruit production offer a constant food supply. Heavy branching, hanging vines and epiphytic plants all contribute homes. Large numbers of different animals are permanent residents; others move in and out on a seasonal basis.

The tropical world abounds with life of all types. Although similiarities exist from one tropical region to the next, the animals and their adaptations can be markedly different from continent to continent. However, in some cases unrelated species have developed to resemble one another simply because they play the same role in different geographic locations. Thus, the peccary of South America is very similar to the forest hog of Africa in both physical characteristics and lifestyle. With large numbers of different species occupying the same

physical space, relationships develop between different types of animals and between animals and plants. Some of these relationships are complex and most are essential to the survival of the species involved.

The major productive region of this forest is the canopy and, as a result, it provides the broadest range of habitat, with not only the largest number of individuals living there, but also the greatest variety of species. Animals are mobile and, therefore, have the capacity to move from one forest layer to another. Many do, making it difficult to establish clear cut criteria for where one lives. Regardless of what layer of the forest a species calls home, they exhibit specific physical and often behavioral adaptations which make them suited to where they live.

THE EMERGENT LAYER

From a comparative point of view, the emergent layer provides permanent residence for only a few species of animals. The relatively thin weak branches of these trees limit the size of the animal that can be supported; consequently, the creatures living there are small and light. The major exception to this generalization is the proboscis monkey of Borneo [a mature male weighs up to 23 kilograms [50 pounds]. Living in small family groups these monkeys feed throughout the canopy but sunbathe and sleep in the emergent trees well out of range of predators. Long fingers and toes aid in running along tree branches. Using their tails as a counterbalance, they springboard the flexible branches of the emergent trees, traveling up to 7 meters [20 feet] through the air in a single leap.

The eagles of the jungle, each continent with its own species, all nest in emergent trees. Building large platform nests where several branches intersect, they use these nests for years. The eagles are top predators of this environment and do most of their hunting in the canopy region. Their wings are shorter and broader than their counterparts elsewhere. This generates sufficient lift to raise the bird almost vertically through the trees as well as allowing for speed and agility. Jungle eagles do not soar but move from tree to tree in short bursts of flight, their grey color acting as effective camouflage.

CANOPY AND UNDERSTORY DWELLERS

The canopy and understory animals show a large range of adaptations associated with locomotion. Hands, feet and tails, if present, are well adapted for climbing up, clinging to, hanging from, and grasping trees. Hooked claws, opposing toes, and prehensile tails all represent adaptations to a life far above the forest floor. Even the tiny tree frogs have suction cups on their toes to prevent them from sliding off slippery wet leaves. Animals of the canopy have developed an assortment of methods of moving through this layer. There are those that fly, glide, and swing, as well as those that run along branches.

In a green world where visibility is limited and water rapidly dilutes scent, color is used not only for camouflage but also as a means of communication, allowing members of the same species to identify each other. Spots and stripes break up silhouettes and shadows, helping animals blend into the dappled light. Noise has its place also. Animals that live in social groups use assorted calls to identify group members and claim territory, while those that live solitary lives may call to attract members of the opposite sex.

The only large, completely herbivorous mammal in the canopy community is the sloth. Found

only in South America, this awkward, slow-moving [with a top speed of 15 feet per hour] creature exemplifies the ultimate of adaptation. Three-inch claws function as hooks, allowing the animal to spend its life hanging upside down as well as being efficient food gathers. Nine vertebrae in its neck [two more than usual for most mammals] allow it great flexibility in turning its head. The sloth's hair grows toward its spine so that it sheds water when in an upside down position, and in the continual dampness, green algae grows in the grooves of its hair, giving it a green tint and acting as a camouflage. Moths lay their eggs in the hair of the sloth with the larval caterpillars appearing to feed on the algae. Slow motion movement is also adaptive in that it is less likely to catch the eyes of the jaguars and harpy eagles, the two top level predators that move in and out of the canopy while hunting.

Other herbivores of these regions include insects, birds, bats, rodents and primates, all of which feed on a variety of plant products, from leaves to flower nectar. Many of the vertebrate species are omnivores, opportunistic feeders that may rely on plants for the biggest percentage of their diet but are not above robbing nests of eggs and young birds or feeding on insects and larva they encounter by chance. Large carnivores are rare, lacking large herbivores as a food source, but all these regions have their own populations of cats and eagles that fill the top predator role. Small carnivores are abundant; amphibians, reptiles, hawks, owls, and carnivorous insects are all represented.

THE FOREST FLOOR

The tropical forest floor is noticeably lacking in the large land herbivores seen elsewhere. Those present are usually perimeter animals because deep in this layer of the jungle there simply is not enough food to sustain them. The forest elephant of Asia with its trunk and the okapi antelope of Africa with its long tongue, both bulk feeders, are adapted to obtaining food from overhead. Rhinoceroses of Malaya, Burma and Sumatra, along with the South American tapiers, all stay near the forest edges; hippopotamuses stay near water. Each of the continents has representative small deer or antelopes that browse on understory trees. The lowland gorilla may climb into the understory to gather food but actually eats its gathered food on the ground. It is interesting to note that there are no representatives of the goat or sheep group present, and the only cow-like animals are the small bushcow of Africa and the tamarou of the Philippines.

Omnivorous members of the pig family forage on the forest floor. The peccary of South America, forest and red river hogs of Africa, and the giant pig [Sus barbatus gargantua] of Borneo all are adapted to rooting and are not picky eaters. Members of the rodent family are found everywhere and many will eat most anything.

The absence of large sources of food limits the number of large predators that can be sustained. The leopard and jaguar both hunt floor animals, and the tiger of India can be considered a forest predator although it tends to stay on the edges where there is a more consistent food supply available on the ground. The sloth bear of India and Sri Lanka lives on the ground and is technically a carnivore; its preferred food is termites that it effectively captures with its long curved claws.

Smaller predators are somewhat more abundant. The bushmaster snake, a pit viper, generally lies curled, covered by ground debris as does the very venomous fer-de-lance. Related to the badgers of North America, the South American grison and tayra are both nocturnal hunters. The giant armadillo and pangolin [a large scaley anteater of Africa and

Asia] are carnivous floor dwellers that live primarily on ants and termites. The only forest dog is found in South America and is rather small. The tiny armored shrew of the Congo is a hunter of insects.

The floor provides a haven for a large assortment of invertebrates. Insects are everywhere, ants and termites being the most common. Other invertebrates one encounters are spiders, scorpions, flatworms, snails, velvet worms, earthworms, and leeches. Varied lifestyles are represented with associated adaptations and relationships. Some eat only the seeds of an individual species of plant and will be found clustered around its base, destroying the seeds that drop there. Under these circumstances, it is essential that the plant develops good seed dispersal methods. This shows the possible advantage for wide separation of individual members of a plant species, *i.e.*, making it more difficult for herbivores, including seed eaters, to find and attack plants.

MAN'S ACTIVITIES/HABITAT DESTRUCTION

The tropical rain forest is the oldest most complex environment on earth. Stable for millions of years, it is now disappearing at a rapid rate. The process of destruction actually began when man discovered fire and developed tools. Over the centuries the process has accelerated with the replacement of hand tools by power tools and the push of increased population.

More people increase the need for food. The soils of the tropics are seldom fertile enough to support conventional agriculture for more than a few years. Low crop yields continually require more land to be put in production. Slash and burn agriculture, with its associated problems of erosion, is common . Abandoned fields do re-colonize, but as secondary forests with different plants and animals. It may take several hundred years to mature and become indistinguishable from primary areas. Recultivation promotes further soil deterioration with poor grasslands eventually becoming established.

For most developing countries, the one accessible resource is the timber of these regions. The tropical timbers that are marketable, however, make up only a small number of the estimated 155,000 species of plants that grow in these forests. It is impossible to selectively log these hardwoods due to the dense vegetation. Clear cutting has become common with the unmarketable plant growth being chipped for paper. Reforestation of the more "valuable" trees is not economically feasible as these species require several hundred years to mature. It has become a major concern to botanists and conservationists that many plants will be extinct before they have even been described, let alone examined for possible useful applications.

The complexity of the tropics is highly interactive and able to maintain itself for long periods of time if left undistrubed. The degree of complexity can be shown by the relationship the Brazil nut tree has with other organisms in its environment. Brazil nuts require a certain type of bee as their pollinator. The pollinating bee requires a certain type of orchid, whose scent the bee uses as an attractant for its mate. This explains why Brazil nuts have not been domesticated away from the region where the bees and orchids are found. Furthermore, in order for the nuts to serve as a seed crop, a particular kind of rodent must be present to chew the fruit enough to soften its

seed coat so germination may occur. Stands of Brazil nut trees must be large enough to support a breeding population of rodents, or the trees will not be able to reproduce.

As the forests fall, so do the animals that live there. The number of animal species that live in these regions is not known [it has been estimated only one-sixth have been given names]. Because these regions are home to so many and in many cases their natural rarity is high, their situation is critical. Animals do not just live in these forests, but form an intergal part of their complexity. The very adaptations that make them so suited to jungle life is their downfall. These animals simply cannot live anywhere else.

PRODUCTS OF THE TROPICS

Hardwood Timbers

Brazil Nut Tree - South America
Rosewood - South America, Asia
Mahogany - South America, Asia, Africa
Ebony - Africa
Zebrawood - Africa
Teak - Africa, Asia
Sandalwood - Asia
Mango - Asia
Balsa - South America
Ironwood - Africa

Spices

Allspice - South America
Pimento - South America
Paprika - Central America, West Indies
Pepper - Central America, West Indies
Carmadon - Sri Lanka, India
Cinnamon - Sri Lanka, India
Vanilla - South America, Central America, West Indies
Mace - East Indies, West Indies
Nutmeg - East Indies, West Indies
Ginger - Asia, Indonesia
Cloves - East Indies, Indonesia

Fibers

Ramie - Brazil, Philippines
Rattan - Asia
Jute - Bangladesh, India
Kapok - Africa, South America, Asia
Bamboo - Thailand, Burma

Fruits/Nuts

Avocado - West Indies
Mango - Malaysia
Coconut - Asia
Figs - Asia
Banana - Asia, South America, Africa
Brazil Nuts - South America
Guava - South America
Cashew - South America
Breadfruit - Asia, West Indies
Papaya - Asia
Liche Nuts - Asia

Others

Coffee - South America
Cocoa/Chocolate - South America
Palm Hearts
Resins - South America, Asia, Africa
Rubber - South America, Asia
Gums - South America
Oils
Dyes
Tanning Agents
Pharmaceuticals
Tapioca

House Plants

Philodendron - South America
Antherium - Central America
Bromeliads - South America
Fiddle Leaf Fig - West Africa
Rubber Plant - East Asia
Croton - Sri Lanka, India, East Indies
Zebra Plant - Brazil
Schefflera 'Umbrella Tree' - Australia, Java, East Indies
Dracaena - Malagasy Republic [Madagascar]
Orchids

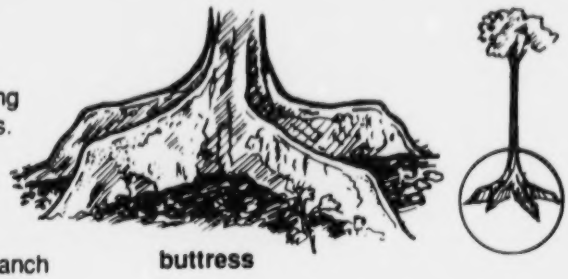
V. GLOSSARY

adaptation - a permanent character or modification of the structure of a plant or animal, which enables it more advantageously to conform to its environment.

arboreal - pertaining to trees or living in the trees.

brachiate [branchiating] -to move along by swinging the arms from one hold to another as do the gibbons.

bromeliads - a group of tropical plants with rosette shape and narrow leaves, often epiphytic.

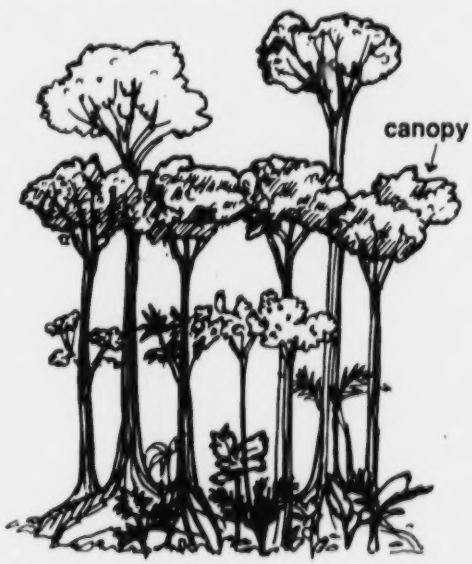


buttress

buttress - appearing as deep ridges, but actually branch roots given off above the ground arching away from the trunk before entering the soil, forming supporting props to the stem.

camouflage - coloration or pattern that allows an animal to blend with its environment.

canopy - the top most layer of twigs and branches of forest trees or other plants, also used to describe the most solid layer of foilage found in the rain forest.



carnivore [carnivorous] - animals that eat meat.

chlorophyll - the green pigment found in plants, responsible for using the sun's energy to make carbohydrates.

cross-pollination - the transfer of pollen from the flower of one plant to the flower of a second plant.

crown - the leafy upper part of a tree.

decomposer [decomposition] - the act of or organism that breaks down or decays complex organic materials into simpler chemical compounds.

dispersal - the spreading of seeds or spores away from the plant that produces them.

drip tip - extremely pointed tip to a leaf that helps drain water from the leaf surface.

emergent - the tall solitary giant trees of the rain forest that stand above the general canopy of the forest.

epiphyte - a plant that lives on the surface of another plant but does not derive water or or nourishment from it.

evaporation - the changing of water from a liquid to a gas.

germination - the process of a seed or spore starting to grow.

guano - the solid excrement of animals, particulary bats and birds.

habitat - the locality or environment in which a plant or animal lives.

herbivore [herbivorous] - an animal that eats plants.

humidity - the amount of moisture air can contain at a given temperature.

humus - dark material formed by the decomposition of animal or vegetable matter forming the organic portion of the soil.

invertebrate - an animal that does not have a backbone.

leaching - washing chemicals out of the soil downwards during drainage.

locomotion - refering to the movement of an animal.

microhabitat - the immediate special environment of an organism, a small place in the general habitat.

monsoon forest - a tropical forest that has a definite wet season and dry season.

nutrient - food substance for a plant or animal.

omnivore [omnivorous] - an animal that eats both animal and plant matter as part of its typical diet.

organic - derived from or showing the peculiarities of a living organism.

organism - any complete or entire living thing.

photosynthesis - the process by which green plants convert sunlight, water, and carbon dioxide to usuable energy called food.

pollination - the act of moving pollen from the male portion of a plant to the female portion.

pollinator - an animal that moves pollen, generally as it feeds from flower to flower.

predator - an animal that kills another for food.

prehensile - an appendage adapted for holding on.

producer - usually a green plant in the environment that has the ability to synthesize organic material from inorganic.

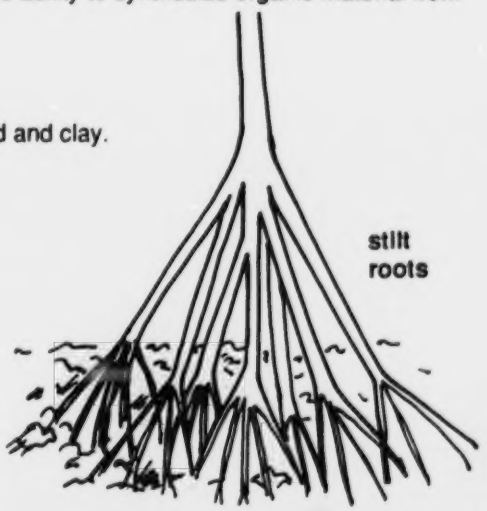
precipitation - the amount of rainfall a given area has.

silt - soil in which the particle size is intermediate between sand and clay.

stilt roots - a form of root that grows from a stem above the ground to aid in the support of the plant.

weather - the action of external factors, physical or chemical, on rocks altering their texture and composition converting them to soil.

wind-pollination - when wind carries pollen from plant to plant rather than some other factor.



VI. COUNTY SUPPORT SERVICES

County Educational Services have many films available to classroom teachers. Below is a partial listing of films and videos, with their catalog descriptions, that deal with the tropical rain forest as an environment. Included is the length of the film and the general age group to which it applies. Individual ESD film libraries only serve the schools in their respective counties. Please preview these before showing.

Amazon - 25 minutes [Junior/Senior High]
This film displays the unique ecological region of the Amazon.

Animals of Asia - 16 minutes [Intermediate/Junior High]
Shows the wildlife of tropical southeast Asia including tigers, cobras, elephants, and rhinos along with the macaques - monkeys that swim, mudskippers - fish that walk out of water, and proboscis monkeys with their long noses.

Animals of South America - 16 minutes [Intermediate/Junior High]
Many of the animals of South America are examined, including army ants, peccaries, the capybara, anaconda, cayman, Andean condors, vicuna, giant anteaters, jaguars and others.

Animals of the South American Jungle - 26 minutes [Junior High]
A alook at the magnificent creatures of the Amazon jungle; students also learn about the lush vegetation and swollen streams that are part of the South American rain forest.

Disappearance of a Great Rain Forest-video- 12 minutes [Junior/Senior High]
Investigates the work of scientists who have been studying the effects of deforestation in the Amazon, the world's greatest rain forest.

Forest in the Clouds - 20 minutes [Junior/Senior High]
Film shows the inhabitants of the tropical ecosystem and various adaptation of plants found there.

Jungle-video- 55 minutes [Junior/Senior High]
David Attenborough makes a vertical journey down a kapok tree whose crown emerges above the jungle canopy. As he descends by ropes to the forest floor below, he finds en route some of the most colorful and extraordinary plants and animals.

Jungles - Green Oceans - 23 minutes [Junior/Senior High]
Jungles' successful and self-contained ecosystems have flourished through the delicately balanced interaction of animals, plants, and climate.

Life in Hot, Rain Forests - 13 minutes [Intermediate/Junior High]
Explains some climatic factors that create a tropical rain forest and how people in one of these areas adapt themselves to the environment.

Life in a Tropical Rain Forest - 14 minutes [Intermediate/Junior/Senior High]
Tropical rain forests make up a major biome characterized by warm weather and heavy rainfall which enourage a wide variety of unique plant and animal life. These regions are now understood to have great influence on the world's climate and ecology.

Life in a Tropical Rain Forest - 30 minutes [Intermediate and above]
An examination of the life in the jungle in Cambodia, the upper Amazon, and island of Barro Colorado in Panama. Shows plants, trees, birds, reptiles and insects that use every amount of available space and waste no energy.

Life in the Trees-video- 58 minutes [Junior/Senior High]
Two ways primates solved the problems of life in the trees were the development of binocular vision and grasping hands. We see lemurs from Madagascar, monkeys from Japan, chimpanzees and mountain gorillas.

Mr. Ludwig's Tropical Dreamland-video- 57 minutes [Intermediate and above]
Daniel Ludwig has replaced a vast primeval Amazon rain forest with commerically valuable trees, floated a pulp mill onto a river whose banks he turned in to a mechanized rice paddy, and carved a city-state out of the wilderness.

Slow as a Sloth - 21 minutes [Intermediate/Junior High]
The unusual structure of this animal is presented by pointing to the relationship between the structure of any animal and its environment.

Tropical Rain Forest - 12 minutes [Junior/Senior High]
Pictures the interrelations of levels of vegetation and animal life within the tropical rain forest, and compares temperature and rainfall to more temperate regions.

Wildlife of the Jungles of Latin America - 17 minutes [Junior/Senior High]
Ecological study of typical plant and animal forms of the rain forests of Latin America. Forest life at four levels, characteristics of plants and animals, interdependence of plants and animals.

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Teacher Evaluation of the Tour Packet

Your evaluation of this tour packet helps us improve future editions and plan new packets in the future. Please take the time to complete this evaluation form and return it to: **Education Division**
Metro Washington Park Zoo
4001 SW Canyon Road,
Portland, OR 97221

This information is optional

Teacher's Name

School Name

School Address

Title of the Packet:

Grade Level of Your Students

Preparatory Activities

Please rate the packet activities you used with your students prior to the field trip to the Zoo.

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
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Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

Zoo Trip Activities

Please rate the packet activities your students worked on while at the Zoo.

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

(Continued on the other side.)

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

Follow-up Activities

Please rate the packet activities you used with your students after the zoo visit.

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

Activity Name:_____

Appropriateness:	**not appropriate**	**1**	**2**	**3**	**4**	**5**	**most appropriate**
Ease of Use:	**very difficult**	**1**	**2**	**3**	**4**	**5**	**very easy**
Effectiveness:	**not effective**	**1**	**2**	**3**	**4**	**5**	**very effective**

COMMENTS:

THANK YOU!

Multi-level Activities

Where In The World Are The Tropics?

23

23

Teacher's Guide to "Where in the World Are the Tropics?"

The object of this activity is familiarize students with the parts of the world that are covered by the tropical rain forest. A large range of map skill levels can be accomodated.

1. Have students draw in and label the equator, and latitude lines for the Tropics of Cancer and Capicorn. This establishes the general boundary lines for where the rain forests can exist.

2. Have students label the oceans, hemispheres, continents, islands, and rivers. Older students can draw in country borders and label countries that fall within these regions.

3. Have students shade, in contrasting colors, the actual rain/monsoon forest regions.

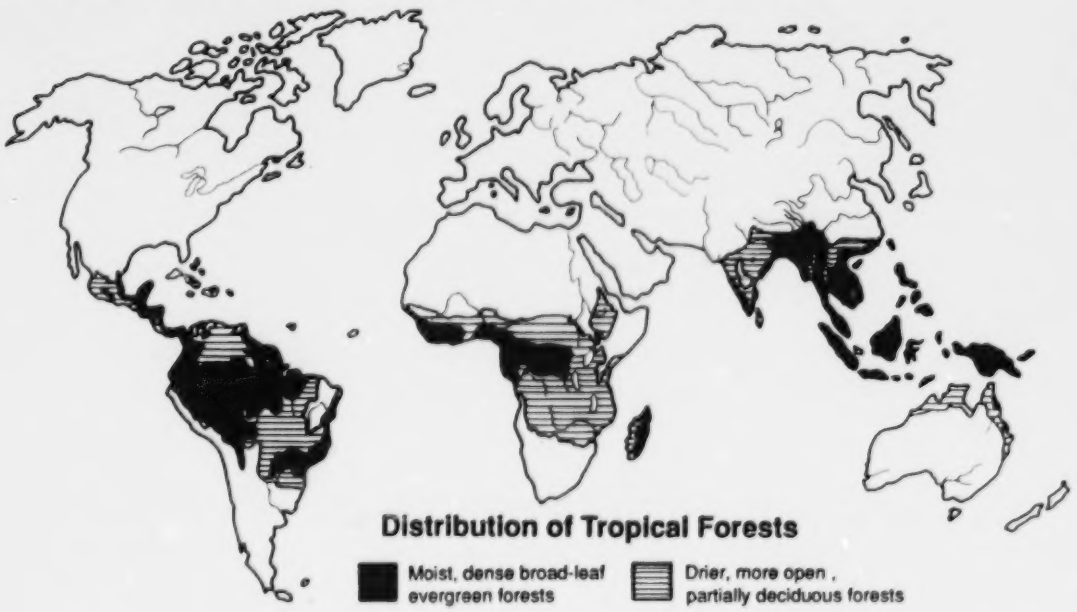
4. Have students draw in the borders of Oregon to show its size and distance relationship to the tropics.

Points of Discussion:

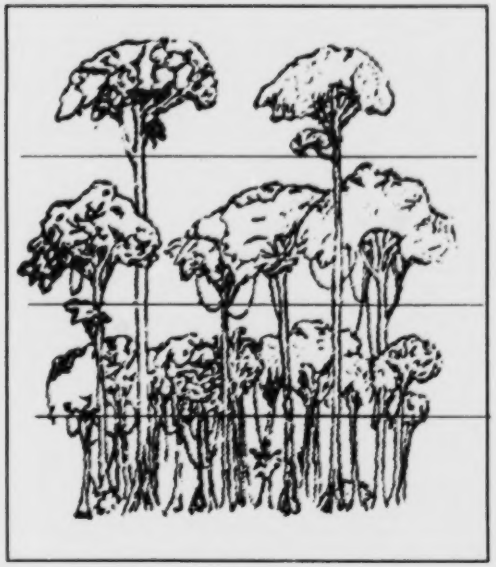
1. Have students note the amount of ocean present in the tropical regions compared to the land mass.

2. Discuss the sun's relationship to the earth and how this affects the day length and temperature of the tropics. If you should choose to use the activities "Here or There" [A comparsion of the tropics to temperate regions] and/or "Two Extremes" [comparing the tropics to the tundra] included in this packet, you may also wish to discuss the seasons of the year and their affect on temperature, plants' growing ability, etc.

3. You may also wish to draw some correlations with the geography of the rain forest and developing third-world countries, as this is a major cause for habitat destruction.

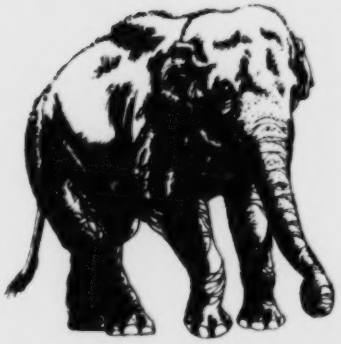

Distribution of Tropical Forests
Moist, dense broad-leaf evergreen forests
Drier, more open, partially deciduous forests

Rain Forest Homes



Forest Layers

Bat



Elephant

Sun Bear

Leopard

Gibbon

Eagle

Butterfly

Teacher's Guide to "Rain Forest Homes"

Students will have more success with this activity if it follows an introduction to the the rain forest's structure. Student instructions have not been included. This allows you to adapt this activity to the level of children you work with.

The objectives of this activity are:

1. To familiarize students with the vertical nature of the rain forest as a habitat.

2. To have students make some decisions based on visible characteristics as to where each animal is most suited to live.
These decisions may be based on:
    1. The animal's size
    2. The animal's method of locomotion

With younger children, you may wish to identify the forest layers as a group activity and then have students draw lines or indicate by letters which animals belong to which layer of the forest. Encourage students to give reasons for an animal's placement; reasons could include: it has wings, it can climb, it is too big, etc.

With older students, this can be carried a step further by having them do some basic research on the animals presented to find out such things as: its food, its periods of activity, its color, its geographic location, etc. and then, have them put together a data chart showing all the information they have discovered. Other possibilities for student research include: types of plants found in each of the layers, uses for these plants, and relationships that each of the herbivorous animals on the list forms with its surrounding vegetation.

Pose this question to your students: "Considering the animals presented, on what continent does this rain forest exist?"

Level 1 Activities

Teacher's Guide to Student Data Sheets
Level 1

The objectives of these activities are to:

1. Improve the observation skills of students.

2. Provide experience in record keeping and organization.

Student Preparation:

1. Each student will need a pencil, a copy of the data sheet/sheets being used and a writing surface [a clipboard is ideal, but a piece of tagboard with the sheets stapled to it is adequate].

2. Introduce students to such note taking skills as abbreviations and using phrases rather than sentences.

3. Let students know what is expected. Review the data sheets with them and have them decide on the appropriate information to be included in each category. Tell them where to find that information. Graphics on the exhibits will give such as information as geographic location and food. "Notes about me!" can range student observations to information from the zoo graphics about behavior and characteristics. It is suggested that you look at the associated activities carefully so that you can direct what sorts of things are recorded. Comment to students about the dynamic nature of zoo exhibits, and that animals come and go. Explain that there is a place on the data sheet for them to mark if an animals listed is not present and that they should be looking for animals not listed to add. There are places at the end of the data sheet for this purpose.

4. Students need to be aware of that fact that there are graphics with important information on the walls of the exhibit buildings and that the graphics on outside exhibits are different than those on the inside [for animals who have the choice of being inside or out].

Use of Student Data Sheets:

These data sheets are organized in sequence with the exhibits and will lead students through with a minimum amount of running back and forth. Because they require students to look at the exhibit as a whole and decide what is important, they eliminate the tendency of children to "look for the answer," and reduce the paper shuffling that occurs when students try to work on specific activities during their actual visit. They provide students with a block of data to be used in conjunction with the other activities presented.

"Mammals of the Tropics is the basic data sheet of the packet and provides the essential information on tropical mammals. It is the only data sheet needed to complete the activities: "How Am I Different?", "?A Puzzle?", and "It's a Rain Forest."

"Living Other Places" covers the Cascades and Tundra exhibits and is used in conjunction with, "Mammals of the Tropics," for the activities "Everyone Lives Somewhere" and "Living Here or There."

"Group Living" is based on two groups of social animals and is the bases for the creative writing exercise "Group Living."

Mammals Of The Tropics

Student Data Sheet Level 1

This data sheet contains a list of animals that may or may not be on exhibit at the Washington Park Zoo. Fill in the information indicated for those animals present. There are blank spaces at the end for animals that fit, but are not listed. Be sure to read the signs and look at pictures that go along with the exhibit.

Not present at the Zoo	Animal	Where do I live?	What do I eat?	What color am I?	Notes about me!
	Jaguar				
	Serval Cat				
	Geoffrey's Cat				
	Temminck's Cat				
	Fishing Cat				
	Mandrill				
	Chimpanzee				
	Ring-Tailed Lemur				
	Siamang				
	White-Cheeked Gibbon				
	Black and White Colobus Monkey				
	Diana Monkey				
	Hanuman Langur				

Not present at the Zoo	Animal	Where do I Live?	What do I eat?	What color am I?	Notes about me!
	Orang-utan				
	Black Howler Monkey				
	Black-Tailed Marmoset				
	Red-Handed Tamarin				
	Hippopotamus				
	Asian Rhinoceros				
	Sun Bear				
	Asian Elephant				

The Problem on Madagascar

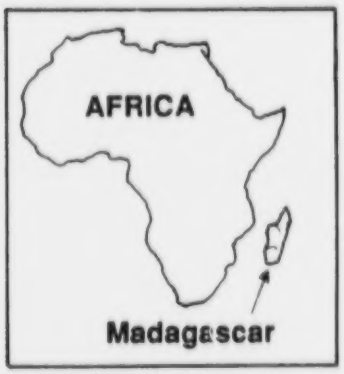
A simulation Game

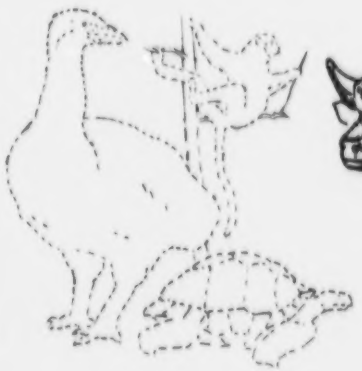
What is Happening on Madagascar?
Background Information:

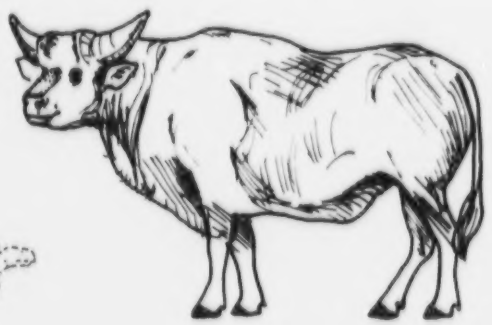
Madagascar, the fourth largest island in the world, lies 400 km [250 miles] off the east coast of equatorical Africa, in the Indian Ocean. The east coast of this island is arid and sandy but close behind these beaches lies a mountain range that extends the island's entire length from north to south. Rain forest climbs over these mountains and straggles off to the west. Geologically, Madagascar is connected to the African mainland, but biologically it possesses its own world of plants and animals. It is a land that lacks almost anything described by biologists as modern, with much of the life there having long ago disappeared from the rest of the earth. The abundant herds of hoofed mammals seen in Africa are totally absent and there are no true cats, apes, dogs, mice, or poisonous snakes. The most characteristic animals of the island are the lemurs. Today there exist some 22 species of these primitive primates, ranging from the small mouse lemur to the indris, nearly three feet tall.

The past 200 years have brought great changes to the Madagascar landscape. Native populations, whose roots are both African and Asian, place high value on zebu cattle as a sign of wealth. Viewing these hump-backed cattle with an almost religious awe, they allow the herds to roam unfenced. The current herds, numbering some 35 million animals, literally eat the land bare. The greater part of the island has been turned into a vast wasteland. Timber harvest, vanilla [imported from Mexico], and sisal plantations have also had an impact. Today less than one-fifth of the forest remains.

Since man arrived on this island at least 10 species of lemurs have disappeared. Gone too are the giant tortoise and ostrich, the elephant bird, and pygmy hippo. Many of the animals live in a particular area of limited size. In many cases, those existing in certain areas possess distinguishing features which give them the status of local varieties. Madagascar is an open air museum in which unusual forms of plants and animals have survived to the present day. At the current rates of destruction, within 20 years, this island will be nothing but a giant red cinder unable to support it's growing human population.







Read and discuss the background information on Madagascar with your students. Some points you might consider covering are:

1. Its geographic location and relationship to Africa.

2. Its size as the fourth island in the world [larger islands are Greenland, New Guinea, and Borneo].

3. The idea that islands have distinct definite limits of space and resources available.

4. The concept of space and food required by every animal regardless of what it is or where it is located.

5. The very special wildlife, particulary the lemurs, found on Madagascar and not found anywhere else.

6. Cattle not being endemic to the island.

7. The native attitude towards cattle in terms of a measure of wealth and being sacred, rarely used for food.

8. The cattle on the island not being fenced or otherwise confined.

The Madagascar Simulation

Use index cards to represent the acres of land on the island. You will need about 50. Have these cards in a stack at the front of the room.

Identify 5 students as Zebu cattle.

Have each of the "cattle" take 2 cards, because each "cow" will need the vegetation found on two acres of ground for food.

At this point discuss with your students:

1. The reproductive rate of cattle. Every cow has the potential of producing one calf per year.

2. The herd will not increase at the rate of 100% per year, due to the presence of males and animals too young or old to reproduce.

3. Populations only remain stable when the birth rate equals the death rate.

4. Every acre needed by the cattle means less space and food available for populations of other animals.

Have the five "cattle" return their cards to the stack, because at this point all of the land is reusable the following year.

It is now **year two**
Identify 3 more students as "cattle" [these represent the offspring of the original five].

Have all seven "cows" come forward and each take two cards.

> At this point discuss the damage done by herds of grazing animals without much space and that as time passes, the land has less opportunity to recover, so some acres are lost.

Retrieve all the cards except 4 [these are lost acres].
It is now **year 3.**
Increase the number of "cattle" to 11 and have each of the "cattle" pick up two cards.

> Point out to your students how much faster the available acres are now being used. The original stack will be visibly smaller.

Year 4
Retrieve all the cards but 6, increase your herd size to 16, each of which gets 2 of the remaining acres.

Year 5
Retrieve all the cards but 8, increase your herd size to 24. Have each "cow" try to take two cards. There will not be enough to go around.

Ask students the following:

> What is going to happen to the cattle who can not get cards?
>
> What is going to happen to the land, now that it has so many cattle on it?
>
> What is going to happen to the other animals that live in this area?

This discussion can be expanded to include possible solutions, keeping in mind the local native attitudes. Attempt to keep students realistic in terms of imposing rules and regulations under these circumstances. Bring out that such solutions are only workable in a cooperative environment, something that does not exist at this point. Furthermore, rules only are effective if you can impose consequences for not following them. What kind of consequences would prove feasible for whole villages of people? You may also wish to bring out that Madagascar is not well developed and that much of it is not easily physically accessible in terms of enforcement, thus presenting still another problem.

Living Other Places

Student Data Sheet Level 1

The Tundra

As you move through the tundra exhibit, fill in Table 1 by answering the questions about the tundra environment.

Table 1 - the Environment

How long are the days in winter?	How long is the summer compared to winter?
How long are the days in summer?	What does the land look like?
What is the temperature like in winter?	How big are the trees?
What covers the ground in winter?	What other plants grow besides trees?

Fill in Table 2 with the information indicated about the animals in the tundra exhibit.

Table 2 - Tundra Animals

Animal	What do I eat?	Do I live alone or in a group?	Give one thing about me that allows me to live where the winters are very cold.
Musk Ox			
Wolf			
Lemming			
Snowy Owl			
Grizzly Bear			
Duck			

The Cascades

The Cascades is where we live. As you walk through the woods towards the Cascade Wetlands exhibit building, answer the questions in Table 3.

Table 3 - The Cascades Forest

What kinds of birds of prey might be found in the forest?
What are the trees like in this forest?
What other plants besides trees may be present?

Like every other environment, one kind of living thing provides food for another. As you enter the Cascade Wetlands building, there are signs that tells you the names we call different living things based on what they eat. Use this information to fill in Table 4.

Table 4 - Basic Food Groups

What is a producer?
What is a consumer?
What is a herbivore?
What is a carnivore?
What is a omnivore?

In the Cascade Wetlands exhibit building, there are various small aquariums and terrariums that contain small animals. Choose five [5] of these animals and fill out Table 5.

Table 5 - Small Stream Animals

Animal	What do I eat?	Who eats me?

In the Cascades exhibit, there are two examples of larger stream animals. Fill in the information about these animals in Table 6.

Table 6 - Larger Stream Animals

Animal	What do I eat?	What kind of nest do I make?	Some notes about me!
Otter			
Beaver			

Everyone Lives Somewhere

A Comparsion of the Rain Forest to the Tundra

In the box below, write five [5] sentences that describe the tundra.

1.
2.
3.
4.
5.

In the box below, write five [5] sentences that descibe the rain forest.

1.
2.
3.
4.
5.

Answer the following questions by telling which environment - the rain forest or the tundra - is described.

	Environment
1. Which environment has the biggest trees?	
2. Which environment has the coldest temperatures?	
3. Which environment has the most grass?	
4. Which environment is hot all the time?	
5. Which environment has days that in the summer are the same as in the winter?	
6. Which environment has lots of rain?	
7. Which environment has long days in the summer and short days in the winter?	
8. Which environment has plants that grow the whole year?	
9. Which environment has snow?	
10. Which place would you rather live?	

Using the information you recorded on your two data sheets, "Living Other Places and "Mammals of the Tropics," fill in the table below with examples of animals that live in the rain forest and tundra.

What Do I Eat?	Tropical Rain Forest	Tundra
Give one animal that eats only plants.		
Give one animal that eats only meat.		
Give one animal that eats both meat and plants.		

Look at your data sheet, "Mammals of the Tropics," and the information you recorded about the orang-utan. In the spaces below, give three problems this animal would have if you moved it to the tundra.

1. _____

2. _____

3. _____

Look at your data sheet, "Living Other Places," and the information you recorded about the musk ox. In the spaces below, give three problems this animal would have if you moved it to a tropical rain forest.

1. _____

2. _____

3. _____

Teacher's Guide to "Everyone Lives Somewhere"

"Everyone Lives Somewhere" is to be used in conjunction with the on-site Zooday student data sheet, "Living Other Places" and "Mammals of the Tropics."

The objectives for this activity are to:

1. Make students aware of the differences that exist between the tropical rain forest environment and the Arctic tundra environment.

2. Increase student understanding about how animals are adapted to survive in their particular environments.

3. Help students understand that animals from different environments are similar at least to the extent that they have basic food requirements.

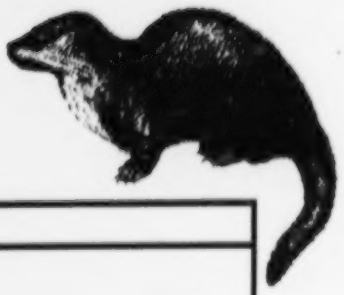
To help students get started on this activity, review the general concept of environment. Discuss the ideas that each region of the world has its own characteristic climate, season length, day length, precipitation, and physical appearance. Bring out the idea that the plant and animal life of these places are limited by and adapted to these environments.

Review for students the nature of the rain forest environment. The specific information concerning the physical environmental features of the tundra should be recorded on the student data sheet, "Living Other Places." Encourage students to apply this information to making decisions about which environment is described.

Use the chart on food groups to show students that although animals from different environments may appear dissimilar in most respects, there does exist a basis for comparsion in terms of their basic food preferences. This chart can also be used to introduce the vocabulary words herbivore, omnivore, and carnivore, and to show the interdependence of food relationships within animal communities. An expansion of this idea is to have students develop food webs for each of the environments, either using animals of their choice or by being given lists of animals found in these environments.

Use the final part of this activity to help students understand that many animals have become so adapted to their environment, they simply can not live anywhere else. Encourage students to come up with their own ideas on the kinds of problems one might have when out of his own environment.

Living Here or There



The Cascades

Food Group	Examples
Producer	
Herbivore	
Omnivore	
Carnivore	

The Rain Forest

Food Group	Examples
Producer	
Herbivore	
Omnivore	
Carnivore	

Teacher's Guide to"Living Here or There"

"Living Here and There" is to be used in conjunction with the on-site Zooday data sheets, "Living Other Places," and "Mammals of the Tropics.

The food relationships that exist in plant and animals communities are basic. Every plant and animal of the community fits into the scheme of energy flow through each environment. The Cascades Wetlands exhibit at the Washington Park Zoo is organized around this flow of energy. This concept can be used as a basis for comparing one environment to another, in this case the cascades to the rain forest.

The objectives of this activity are to:

1. Review the interdependent food relationships that exist in environments.

2. Make students aware of the energy flow that occurs within communities of plants and animals.

3. Give students practice in sorting, categorizing, and organizing data using food relationships as a criteria.

Procedure:

1. Start this activity with your class as a group using their data sheet, "Living Other Places," as a reference. Have the group brainstorm a list of plants and animals that live in the Cascades. This list needs to contain 15-25 living organisms of which approximately 5 need to be plants. Record these organisms on the chalk- board.

2. Review the terms producer, herbivore, carnivore, and omnivore, emphasizing that all living organisms will fit into one of these groups. Students should have the definitions of these terms on their data sheet, "Living Other Places."

3. Break the large group into smaller groups of 3-4 students and have them sort the brainstormed list into the food categories of the Cascades section on the activity sheet "Living Here and There."

4. Repeat steps one and three for the tropical rain forest environment, with students using their data sheet, "Mammals of the Tropics," as a reference. Encourage students to come up with appropriate animals in addition to those they saw at the zoo, including reptiles, amphibians, and insects. Once again this list must include some plants. With help, students can usually identify some of the more commonly known tropical plants such as palm tree, bamboo, orchids, etc.

5. Discuss with students the concept of the sun as the only source of energy to the community and the producers being responsible of converting this energy into food that can be used by animals, for their source of energy.

6. Provide individuals or small groups with large sheets of paper and have students build food webs for each of the groups of organisms they now have recorded on the two tables on the activity sheet, "Living Here and There." Arrows can be used to indicate the energy flow from the sun to the producers and back and forth showing who eats what.

This concept can be expanded to include decomposers and the role they play in the environment recycling nutrients back through decomposition.

Other possible topics of discussion include:

1. The place of man in these communities with repect to food relationships.

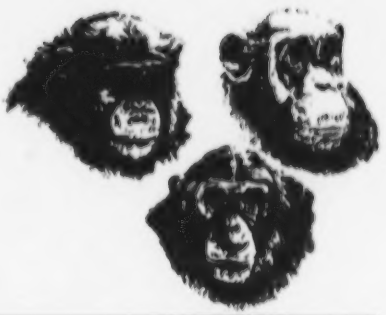
2. Human cultures that can live in harmony with these environments as opposed to those cultures that live in conflict with the environment.

3. The affect of interrupting the flow of energy through the environment by removing key organisms from the community.

4. How food supply affects population numbers of some organisms, particulary members of the carnivore group.

Group Living

Student Data Sheet Level 1



While you are in the primate building, watch the chimpanzees for a few minutes. Chimpanzees live in groups called TROOPS. Pick out the youngest member of the troup and fill in Table 1 below by completing the sentences.

Table 1 - What Am I Like? - A Description

My color is	My fur is
I move across the ground by	I climb by
My face is	My size is

In Table 2, write down 10 things the baby chimpanzee does.

Table 2 - What Do I Do? - An Observation

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Write a sentence about how you feel about this baby animal.

OVER

While visiting the elephant enclosure, watch the elephants for a few minutes. Elephants live in groups called HERDS. Pick out the youngest animal of the herd and fill in the Table 1 below by completing the sentences.

Table 1 - What Am I Like? - A Description

My color is	My size is
My fur is	My trunk is
I move by	My feet are

In Table 2, write down 10 things the baby elephant does.

Table 2 - What Do I Do? - An Observation

1.
2.
3.
4.
5.
6.
7.
8.
9.
10

Write a sentence about how you feel about this baby animal.

Group Living

The chimpanzee and the elephant both live in the rain forest. They both live in groups. The chimpanzee lives in a TROOP and the elephant lives in a HERD. At the Washington Park Zoo, you observed a chimpanzee troop and an elephant herd and wrote down information about what it is like to be the youngest member of these groups.

Using your information sheet on Group Living, write a story about the baby chimpanzee meeting the baby elephant.

Teacher's Guide to "Group Living"

Children encountering groups of social animals are often overwhelmed by all the activity and motion that exists. This can cause them to miss the fact that a distinct social structure is present and that individual animals form relationships with every other group member. By asking a child to focus on one animal in the group, their attention is concentrated on what that animal is doing and how it relates to other group members, as well as how they relate to it. A young animal is used for several reasons: 1] they tend to be more active; 2] the structure that surrounds the young is not as rigid; 3] they are more easily identified; and 4] children find them fun to watch.

The Washington Park Zoo has good sized groups of chimpanzees and elephants with a distinct social structure. The size of these groups and the fact that in both cases it takes considerable time [years] for the young to mature, insures that there are usually always individuals present that fit the category of being "babies."

The objectives of this activity are to:

1. Provide students with some guided observation that focuses their attention on a specific animal.

2. Make students aware that in some animal groups a definite social structure exists that involves some degree of individual cooperation.

3. Give students practice in writing down what they see, then organizing these observations into a creative written report.

Have students complete the "Group Living" student data sheet while visiting the primate house and elephant enclosure. Students then use this data sheet to complete the creative writing assignment about the baby chimp meeting the baby elephant.

?A Puzzle?

Read each clue and unscramble the letters to write the name of the animal described in the blanks provided. When you are finished, spell another word having to do with the tropics using the letters that fall in the squares.

HTEANLEP

_ □ _ _ _ _ _ _ _ _ I am a forest floor animal that can reach high over my head for food.

UNS REBA

_ _ □ _ _ _ _ _ My short smooth fur does not get snagged by branches as I climb through the trees.

HNMECEPZIA

_ _ _ _ _ _ _ _ _ _ _ □ I am a good climber but spend most of my time on the ground.

AARJUG

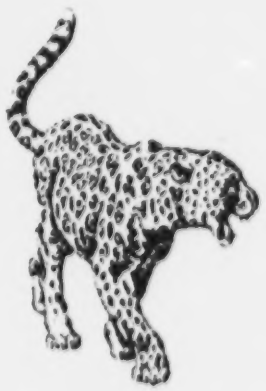
□ _ _ _ _ _ _ My spotted coat hides me when I am hunting for food.

BOOSLUC KMYENO

_ _ _ _ _ _ □ _ _ _ _ _ _ _ _ My long fur acts as a parachute when I jump from tree to tree.

TRNNAAOUG

_ _ _ _ _ □ - _ _ _ _ _ I am a large red primate that leads a solitary life.



The word in the squares is _ _ _ _ _ _ _ 56

Teacher's Guide to "? A Puzzle?"

This activity is to be used in conjunction with the student data sheet "Mammals in the Tropics." The student objectives for this activity include:

1. Reinforcing that each animal has specific adaptations that make it identifiable and unique.

2. Reinforcing that adaptations are what allow an animal to be highly suited to its habitat and the role it plays in the environment.

3. Making students aware that a mass of data can be used in several ways.

Answers:

elephant
sun bear
chimpanzee
jaguar
colobus monkey
orang-utan

The word in the squares is: JUNGLE

It's A Rain Forest

Below are 9 words that all have something to do with the rain forest. Give a "rain forest" definition for each of the words.

In these 9 words there are letters which make the name of a Washington Park Zoo tropical rain forest animal. Unscramble the letters in the boxes to find the name of this animal.

	RAIN **A**
EQUATOR **A**	CANOPY **N**
FLOOR **R**	HUMID **U**
VINE **N**	ARBOREAL **O**
HOT **T**	EMERGENT **G**

The Tropical Zoo Animal is _____

Teacher's Guide to "It's a Rain Forest"

The objective of this activity is to review some of the vocabulary that refers to the rain forest.

This activity has a combination of words; some of which are part of students' familiar vocabulary such as hot, rain, and floor, while some will be new and rather difficult such as arboreal and emergent. This will allow students to apply new, rather specific, definitions to the familiar words, helping students to realize that often we must "fit" the definition to the circumstances. The hard words in this case are very specific to this particular environment, and this will help students incorporate them into their vocabulary.

The Tropical Zoo Animal is the ORANG-UTAN.

How Am I Different?

Use your data sheet, "Mammals of the Tropics," to decide what characteristics you can use to divide the primates into two groups. Take each new group formed and divide it also into two groups based on some way the animals are different. Continue dividing each group into two until you end with a group of only one type. This has been started for you to show you how it works.

I have no tail

I make a nest at night

I am black

I am red

I don't make a nest

I am all black

I have a white face

I have a tail

I am from the Old World

I am from Asia

I am not from Asia

I am from the New World

I have a prehensile tail

I don't have a prehensile tail

G1

G2

Teacher's Guide to "How Am I Different?"

The objectives of this activity are to show students one of the many ways data can be used and to provide practice at organization and decision making.

This activity takes a group of organisms with different characteristics, and by using a two-choice system, divides the original group into two. It then takes each new group and divides them into two groups. It continues doing this until it ends with several groups, each with a different kind of organism. This technique is used by biologists when constructing a classification device called a dichotomous key. These keys are used to identify living things to their scientific names.

In this case the students are asked to use the zoo primates as their initial group. To get them started and show them how it works, this group has been divided into two. The upper group [primates with no tails] is taken down to the end of the key, or a group of one. The lower group [primates with tails] is only started and students must complete not only the divisions but also decide what characteristics to use. As they move across the page, each group should becomes smaller and smaller, until it ends with a group of one type of primate. The characteristics students use should be either actually visible [such as color] or given in the zoo graphics [such as nest building]. Students should have recorded this information on their "Mammals of the Tropics" data sheet.

Once the written task is completed, it can be used to show students how a classification system works, by playing the following game:

1. Identify one member of the class as one of the primates [*i.e.* a chimpanzee]. Have him/her keep what he/she is a secret.

2. Other class members can ask that student one question at a time, working across the sheet from left to right. The identified student can only answer yes or no. Yes answers indicate what the next questions should be.

    Do you have a tail? [answer no]
    You don't have a tail? [answer yes]
    Do you make a nest at night? [answer yes]
    Are you red? [answer no]
    Are you black? [answer yes] -- The chimp is the only animal that fits all the yes answers.

Teacher's Guide to Student Data Sheets
Level 2

The objectives of these activities are to:

1. Improve the observation skills of students.

2. Provide experience in record keeping and organization.

Student Preparation:

1. Each student will need a pencil, a copy of the data sheet/sheets being used and a writing surface [a clipboard is ideal, but a piece of tagboard with the sheets stapled to it is adequate].

2. Introduce students to such note taking skills as abbreviations, concise wording, and using phrases rather than sentences.

3. Let students know what is expected. Review the data sheets with them and have them decide on the appropriate information to be included in each category. For example, environmental adaptations includes such things as long arms for swinging, prehensile tails for hanging, color patterns for camouflage and communication, noise making, rump pads for perching on branches, trunks for overhead feeding, size, etc. Comment to students about the dynamic nature of zoo exhibits, and that animals come and go. Explain that there is a place on the data sheet for them to mark if an animal listed is not present and that they should be looking for animals not listed to add. There are spaces at the end of the data sheet for this purpose.

4. Students need to be aware that they must read the graphics that accompany each exhibit. These graphics are the source of a great deal of information. Caution students to look at those on the walls of the exhibit buildings and outside cages [for those animals have a choice of being inside or out].

Use of Student Data Sheets

These data sheets are organized in sequence with the exhibits and will lead students through with a minimum amount of running back and forth. Because they require students to look at the exhibit as a whole and decide what is important they eliminate the tendency of children to "look for the answer," and reduce the paper shuffling that occurs when students try to work on specific activities during their actual visit. They provide students with a block of data to be used in conjunction with the follow-up activities included.

"Mammals of the Tropics" is the basic data sheet of the packet and provides the essential information on tropical mammals. It is the only data sheet needed to complete the activities "Living Around the World" and "Rain Forest Living."

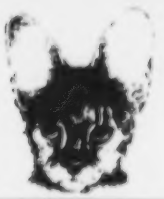
"The Other Extreme" is over the Tundra exhibit and along with, "Mammals of the Tropics," provides the information for the activity "Two Extremes."

"Monkey Business - Primate Behavior" is the basis for the creative writing exercise, "Monkey Business."

"The "Here" of Here and There" covers the Cascades Wetlands exhibit and is used with, "Mammals of the Tropics," to complete "Here and There" a comparative activity based on food relationships.

Mammals Of The Tropics

Student Data Sheet Level 2



This data sheet contains a list of animals that may or may not be on exhibit at the Washington Park Zoo. Fill in the information indicated for those animals present. There are blank spaces at the end for animals that fit, but are not listed. Be sure to read the signs and look at pictures that go along with the exhibit.

Not present at the Zoo	Animal	Scientific Name	Country/ Range	Diet	Color/ Pattern of Markings	Adaptations to Environment
	Jaguar					
	Serval Cat					
	Geoffrey's Cat					
	Temminck's Cat					
	Fishing Cat					
	Mandrill					
	Chimpanzee					
	Ring-Tailed Lemur					
	Siamang					
	White-Cheeked Gibbon					
	Black and White Colobus Monkey					
	Diana Monkey					
	Hanuman Langur					

Not present at the Zoo	Animal	Scientific Name	Country/ Range	Diet	Color/ Pattern of Markings	Adaptations to Environment
	Orang-utan					
	Black Howler Monkey					
	Black-Tailed Marmoset					
	Red-Handed Tamarin					
	Hippopotamus					
	Asian Rhinoceros					
	Sun Bear					
	Asian Elephant					

The "Here" of Here and There

The Cascades Wetlands - Student Data Sheet Level 2

Table 1 - Food Web Terminology

Term	Definition
Producer	
Consumer	
Herbivore	
Carnivore	
Omnivore	
Decomposer	

As you move through this exhibit, make a list of the plants that live near the water or actually in the water. List as many as you can [don't forget to include the ones given to you on the various signs].

As you enter the Cascades Exhibit there are a series of aquariums and terrariums with assorted small animals. Choose 5 of these and fill in Table 2 below.

Table 2 - Stream Organisms

Animal	What it eats?	Who eats it?

Table 3 - Larger Wetland Animals

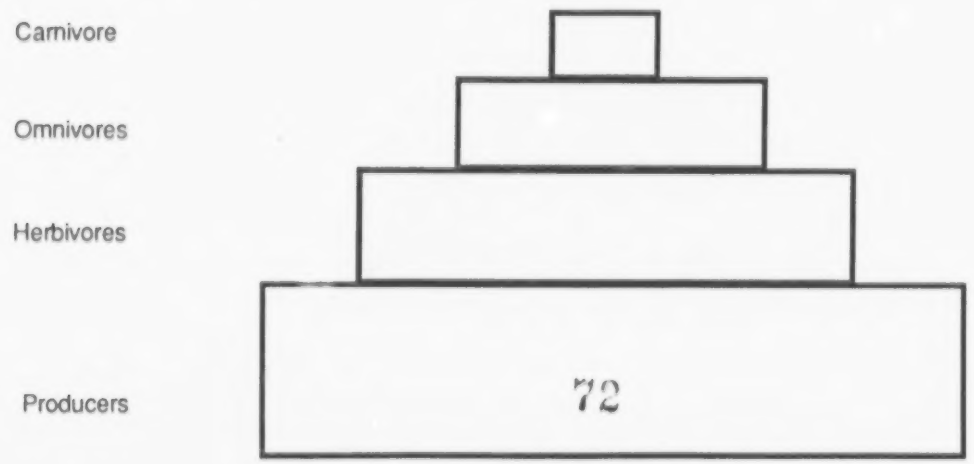
Animal	Food	Nesting/Family Behavior	Adaptations
Otter			
Beaver			

Beyond the beaver and otter part of the exhibit there is a second wall with aquariums and terrariums. Choose five of these to fill out Table 4 below.

Table 4 - More Stream Organisms

Animal	What it eats?	Who eats it?

At the end of the exhibit there is a picture a little like the one below indicating the pond biomass. Fill in the names of the organisms that belong at each of the levels.



POND BIOMASS

Here and There

Cascade Wetlands	
Algae	Diatoms
Alligator Lizard	Douglas Fir
Beaver	Great Blue Heron
Big-leaf Maple	Mallard Duck
Caddis Fly Larvae	Otter
Cattails	Rainbow Trout
Common Garter Snake	Red-legged Frog
Crayfish	Water Weeds

Take the organisms from the wetlands and the rain forest listed to each side and arrange in the chart below according to their food relationships. Draw an arrow from each animal to show what it eats.

Tropical Rain Forest	
Chameleon	Mango Tree
Elephant	Orchid
Fern	Palm Tree
Fig Vine	Parrot
Fruit Bat	Peacock
Geoffrey's Cat	Python
Jaguar	Ring-tailed Lemur
Mahogany Tree	Siamang

The arrows show who eats what.

Carnivore

Omnivore

Herbivore

Producer

Wetlands	Rain Forest

Teacher's Guide to " Here and There"

" Here and There" is to be used in conjunction with the on-site Zooday data sheet, "The "Here" of Here and There," which covers the Cascades Exhibit.

The objectives of this lesson are to:

1. Show the food gathering relationships that exist in every environment.
2. Show the same food roles are filled by different animals from environment to environment.
3. Indicate the interdependence of living organisms when obtaining food.
4. Introduce the basic vocabulary of food groups.
5. Develop the concepts of food chains and food webs.
6. Indicate one of the ways environments can be compared.

Have students use their two student data sheets "Mammals of the Tropics" and "The "Here" of Here and There" to complete the charts on the two environments.

This can be greatly expanded by drawing on student knowledge about Northwest environments. Possibilities include:

Comparing elk and/or deer to elephants
Comparing local birds to tropical birds
Comparing the cougar, lynx, and bobcat to the tropical cats
Discussing the structure of local forests to the rain forest
Discussing the variety of species present in the two environments
Comparing the habitats of small mammals of both environments.

If you have bulletin board space available, students can construct complicated food webs for either or both environments using pictures and string.

Monkey Business

Primate Behavior - Student Data Sheet Level 2

Each species of primate has a developed social structure that determines the way individuals of a group relate to one another. Some primates such as the orang-utan are solitary, while others such as the baboon live in large complex groups. Observing primates gives clues to the social interactions among members of a group. The Washington Park Zoo has an excellent collection of primates, with several species represented. Since the activity of any group varies from day to day, by the hour of the day, as well as the season of the year, it is hard to predict which group will be most active at any given time and thus most interesting to watch. Choose **four** groups of primates to observe to complete this data sheet. Watch each group for at least **five** minutes recording the behavior that you see. Look for how individual animals react to each other as well as what activity each individual is engaged in.

Animal	Individuals per group			General Behavior		
	# of males	# of females	# of young	Males	Females	Young

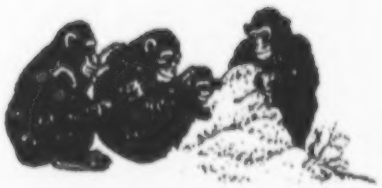
Check the graphics at each exhibit, those outside as well as those inside. These will give you facts about the behavior of the animals. These facts include information on nesting, feeding, communication, care of young, etc. The spaces below are for you to record this data for the four groups of animals you chose to observe.

Animal	

Monkey Business

Choose one of the groups you observed. Write a story about being a "teen-ager" in this group. Include such things as:

where you live and what its like
what you do during the day
what you do at night
how you move
what you eat
how you get your food
how you get along with your mom, dad, other females in the group, and other children.
what you do with others and what they do with you
how you communicate
who takes care of you
who decides what the group does and where it goes



Chimps using a tool to get termites from mound.

Cold, ring-tailed lemurs all pile up together to keep warm.

Orangutans build new nests every night.

Teacher's Guide to "Monkey Business"

The activity" Monkey Business" is to be used in conjunction with the student data sheet on primate behavior. The objectives of this activity include:

1. Increasing observation skills.

2. Having students realize that observation may mean more than just a quick glance.

3. Giving students some practice at interpreting what they see and drawing some conclusions based on these interpretations.

Primates are facinating to watch. However, to appreciate the complex social structure and relationships that exist within any primate group takes some time. The data sheet allows students to make a choice about which groups they wish to watch. Students will be more successful with this if they choose a group that is reasonably active at the time.

For this data sheet to be most meaningful, students should be encouraged to watch for and note the following types of behavior:

In general what does each individual of a group appear to be doing?

- foraging
- grooming
- sleeping
- playing
- supervising

What is the behavior of young animals compared to the adults?
What evidence is there of maternal care?
What facial expressions various animals make?
who appears to be the dominant member?
How the animals move?

- climbing
- running
- jumping
- swinging
- walking

What is the use of hands, feet, and tails for holding and grasping objects?

Have students read the graphics on the walls of the primate building as well as those on the exhibits. Caution students that for those animals that have a choice of being out or in, the graphics on the outside exhibits differ from those inside.

Rain Forest Living

Directions: Using your data sheet "Mammals of the Tropics" fill in the names of the animals that show the adaptations described. Take the letter that falls over the numbered spaces and place it in the space numbered the same at the end of the exercise to form a concept for this lesson.

1. The method by which I move is called branchiating.

2. I can hang from the trees with my prehensile tail.

3. I use my vocal sacs to make a loud booming noise, letting others know where I am.

4. My long fur acts as a parachute, slowing my fall when I jump from tree to tree.

5. My blue face and rump allow members of my species to identify me.

6. My large ears allow me to hear my prey.

7. I participate in scent fights with other males to determine dominance.

8. My partially webbed front feet help me catch fish.

9. My small size allows me to move easily through the forest canopy.

10. The red color on my thighs helps others identify me.

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11. My short fur lets me move through trees without being snagged.

32 10 35 43

12. My trunk allows me to feed on tree branches.

57 1 20

13. Kuckle-walking lets me travel across the ground rapidly.

17 25 60 67

14. My memory is exceptionally good and I return to the same fruit trees to feed year after year.

9 59

15. My spotted coat acts as excellent camouflage in the dappled light.

58 61 19

16. My large pupils let me see even in very dim light.

52 36 48

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67

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Teacher's Guide to Rain Forest Living

The objective of this lesson is to indicate to students that each tropical animal has unique features that make it suitable to live in the rain forest. It also reinforces the idea that the student data sheet "Mammals of the Tropics" is useful for several tasks.

ANSWERS:

1. white-cheeked gibbon
2. black howler
3. siamang
4. colobus monkey
5. mandrill
6. serval cat
7. ring-tailed lemur
8. fishing cat
9. Geoffrey's cat
10. Diana monkey
11. sun bear
12. elephant
13. chimpanzee
14. orangutan
15. jaguar
16. Temminck's cat

LESSON CONCEPT

PHYSICAL AND BEHAVIORAL ADAPTATIONS ARE NECESSARY FOR SUCCESSFUL JUNGLE LIFE

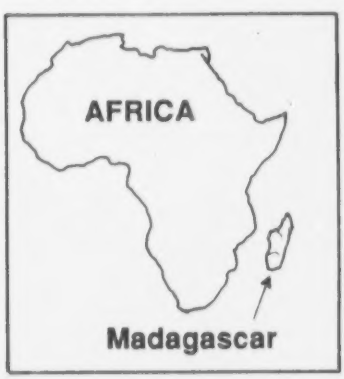
What Is Happening on Madagascar?

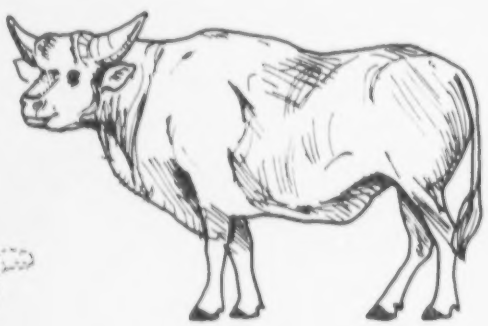
Background Information:

Madagascar, the fourth largest island in the world, lies 400 km [250 miles] off the east coast of equatorical Africa, in the Indian Ocean. The east coast of this island is arid and sandy but close behind these beaches lies a mountain range that extends the island's entire length from north to south. Rain forest climbs over these mountains and straggles off to the west. Geologically, Madagascar is connected to the African mainland, but biologically it possesses its own world of plants and animals. It is a land that lacks almost anything described by biologists as modern, with much of the life there having long ago disappeared from the rest of the earth. The abundant herds of hoofed mammals seen in Africa are totally absent and there are no true cats, apes, dogs, mice, or poisonous snakes. The most characteristic animals of the island are the lemurs. Today there exist some 22 species of these primitive primates, ranging from the small mouse lemur to the indris, nearly three feet tall.

The past 200 years have brought great changes to the Madagascar landscape. Native populations, whose roots are both African and Asian, place high value on zebu cattle as a sign of wealth. Viewing these hump-backed cattle with an almost religious awe, they allow the herds to roam unfenced. The current herds, numbering some 35 million animals, literally eat the land bare. The greater part of the island has been turned into a vast wasteland. Timber harvest, vanilla [imported from Mexico], and sisal plantations have also had an impact. Today less than one-fifth of the forest remains.

Since man arrived on this island at least 10 species of lemurs have disappeared. Gone too are the giant tortoise and ostrich, the elephant bird, and pygmy hippo. Many of the animals live in a particular area of limited size. In many cases, those existing in certain areas possess distinguishing features which give them the status of local varieties. Madagascar is an open air museum in which unusual forms of plants and animals have survived to the present day. At the current rates of destruction, within 20 years, this island will be nothing but a giant red cinder unable to support it's growing human population.





Consider the following problem:

You have a herd of ten zebu cattle. Cattle are grazing animals and each requires the amount of vegetation produced by 2 acres of land to live. Your herd of cattle can be expected to increase at a minimum rate of 30% per year over the next ten years.

Fill in Table 1 below, to show the yearly increases in your herd and the amount of land it will take to support them for a period of ten years [round off your numbers to the nearest whole number].

Table 1 - Increase of Cattle Herd

Year	Number of Cows	Acres of Land Needed
1	10	20
2	13	
3		
4		
5		
6		
7		
8		
9		
10		

Questions:

1. Why doesn't your herd of cattle increase at a rate of 100% per year?

2. What happens to the amount of land you need as the number of animals increases?

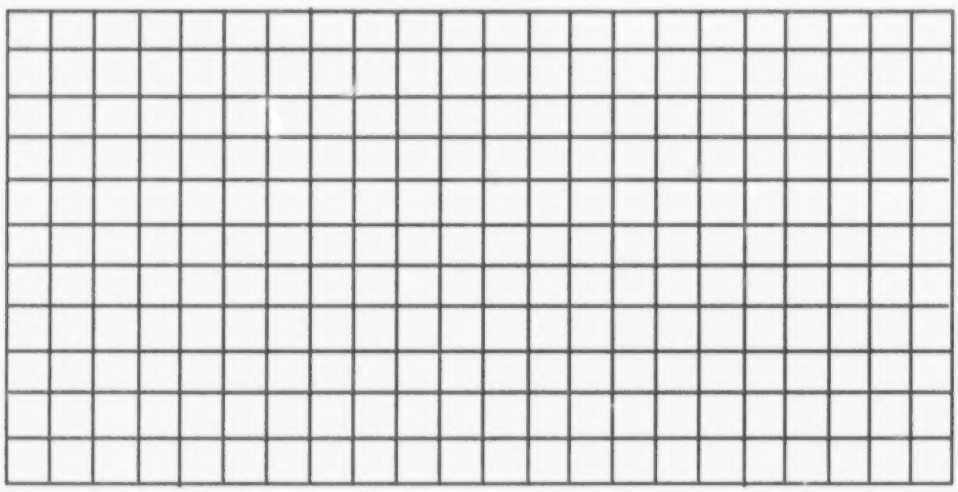
3. What will happen if your herd of animals is allowed to increase at this rate for 20 years?

4. How are cattle viewed on the island of Madagascar?

5. As the size of the herds increase, what happens to the amount of land needed to support them?

6. As the amount of land needed to graze cattle increases, what happens to the amount of land available for other animals?

Graph the data in Table 1 on the grid below, using the horizontal axis for the acres required and the vertical axis for the number of cows in the herd.



Teacher's Guide to "What is Happening on Madagascar?"

By using the "real life" example of the problem that exists on Madagascar, this activity incorporates a potentially broad range of student skills including geography, mathematics, including graphing, and social studies.

The objectives of this activity are:

1. To make students aware of man's actual impact on a limited environment.

2. To show the effect when cultural attitudes and values of man conflict with the needs of wildlife.

3. To show the dynamics of population growth.

Have students read the background information section on the activity sheet. At this point discuss the following with your students.

1. The geographic location of Madagascar and its relationship to Africa.

2. The defined limitation of space that exist on islands, even very large ones.

3. The uniqueness of Madagascar, in that it's wildlife is decidedly different than the rest of the world.

4. The already rapid extinction rate for native wildlife seen on this island.

5. That animals, regardless of type or location, all have a basic requirement for space and food.

6. The attitudes of man and his cultural values are an issue in determining the importance of and emphasis placed on land use.

Have students read the problem and accomplish the calculations to complete Table 1.

Table 1 - Increase of Cattle Herd

Year	Number of cows	Acres of Land Needed
1	10	20
2	13	26
3	17	34
4	22	44
5	29	58
6	38	76
7	49	98
8	64	128
9	83	166
10	108	216

Discuss the following points.

1. The reproductive cycle of cattle based on a gestation period of about 9 months and sexual maturity being reached at approximately one year.

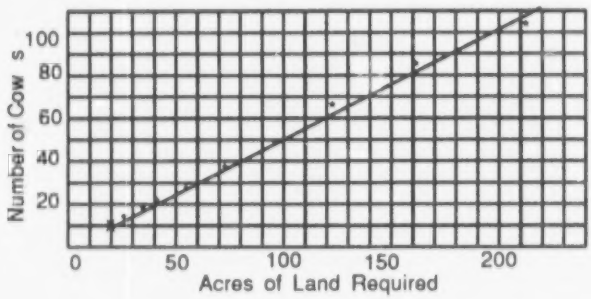
2. The dynamic nature of populations with respect to birth rate, death rate, sex, and age of the herd, with an average individual reproductive life span of about 15 years.

3. Why, although no population actually doubles in one reproductive cycle, a 30% increase may be conservative when no predators are present and no slaughter for human consumption occurs.

4. The stress that can be placed on an environment by domestic livestock.

5. That although it is not reflected by Table 1, the total amount of land required at the end of ten years may be considerablely more, due irreversiable damage caused by over grazing. In this case, this is a valid assumption due to the lack of technology concerning soils and land management seen in primitive societies and cultures.

Have students complete the graph showing their data in Table 1.



Discuss at this point:

1. The continual growth of unchecked populations, literally until they run out of room.

2. The acceleration of growth that occurs as the inital size of the population increases.

3. What has to happen to the wildlife of this locality under these conditions, remembering that for every acre required by the cattle leaves less space and food for other animals.

This discussion can be expanded to include possible solutions, keeping in mind the local native attitudes. Attempt to keep students realistic in terms of imposing rules and regulations under these circumstances. Bring out that such solutions are only workable in a cooperative environment, something that does not exist at this point. Furthermore, rules only are effective if you can impose consequences for not following them. What kind of consequences would prove feasible for whole villages of people? You may also wish to bring out that Madagascar is not well developed and that much of it is not easily physically accessible in terms of enforcement, thus presenting still another problem.

The Other Extreme - The Tundra

Student Data Sheet Level 2

Facts to find out about the environment:

1. Geographic location - _____

2. Land mass covered - _____

3. What is **permafrost**? _____

Table 1 - The Tundra Environment

Day Length		Season Length		Precipitation Annual	General Characteristics
Summer	Winter	Summer	Winter		

Table 2 - Tundra Habitats

Habitat	Animals that Live There
High Bush	
Alpine Tundra	
Moist Tundra	
Wet Tundra	

Facts to find out about tundra animals:

1. What major group of animals is missing from the tundra? _____

2. What relationship exists between the number of lemmings and snowy owls? _____

_____

3. Name three animals that change color in the winter - _____

4. What do most arctic birds do to survive the winter? _____

5. What is different about the hunting behavior of snowy owls? _____

Table 3 - Tundra Animals

Animals	Diet	Adaptations to Winter	Behavior
Musk Ox			
Wolf			
Lemming			
Snowy Owl			
Grizzly Bear			
Harl equin Ducks			

Table 4 - Tundra Soils

Depth of Active Zone	What they are Poor in	Source of Nutrients	How They are Made	Amount of Moisture Available

Table 5 - Tundra Plants

Plants	Adaptations to the Environment
Arctic Willow	
Heather	
Cotton Grass	
Moss Campions	
Bearberry	
Arctic Poppy	

Two Extremes

A Comparsion of the Tropical Rain Forest to the Tundra

The Environment

Give the condition below for each of the two environments.

Tropical Rain Forest

Tundra

	Day Length/Summer	
	Day Length/Winter	
	Season Length/Summer	
	Season Length/Winter	
	Temperature/Summer	
	Temperature/Winter	
	Annual Precipitation	
	Depth of Available Soil	
	Way Soil is formed	
	Factors that Limit Life	

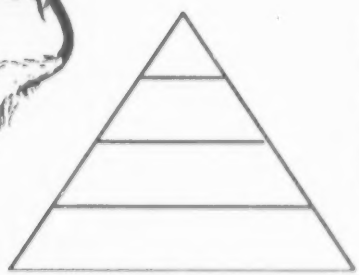
Plant Adaptations

Directions: Give one adaptation of a typical plant from each of the two environments to the conditions listed below.

	Wind	
	Moisture Available	
	Temperature	
	Light Available	
	Season Length	

Who Eats What?

Directions: Give the examples indicated below for each of the food pyramids. The one to the right is for the Tundra the one to the left is for the Rain Forest.

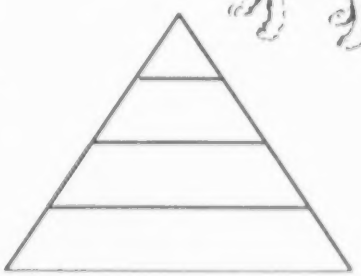


Top Level Consumer - Give two examples of carnivores for each region.

Secondary Consumer - Give an example of an omnivore for each region.

Primary Consumers - Give two examples of herbivores for each region.

Primary Producers - Give the major plant type of each region.



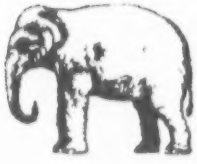
Below are three general groups of animals found in the tundra and the rain forest with a series of questions about each. Answer each question about both the tundra animal and the rain forest animal. Use an extra sheet of paper if necessary.

Owls Live Everywhere

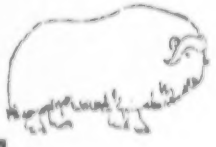
Directions: Compare the great horned owl, which ranges south into the rain forest to the tundra snowy owl by answering the questions below.

	What is its color?	
	Where does it nest?	
	When does it hunt?	
	What does it eat?	

Life in a Herd



Directions: Compare the elephant to the musk ox by answering the questions below.



	Which animal sexes are found in the herd?	
	What does it eat?	
	How does it obtain food?	
	What characteristics show adaptation to temperature?	
	What are the benefits to herd life?	

Big or Little

Directions: Compare the sun bear to the grizzly bear by answering the questions below.

	What is its color?	
	What is its size?	
	What does it eat?	
	What is the length of its fur?	
	What is its climbing ability?	
	What are its feet like?	

Teacher's Guide to "Two Extremes"

"Two Extremes" is to be used in conjunction with the on-site Zooday student data sheet "The Other Extreme - The Tundra."

The objectives of this lesson are to:

1. Reinforce the differences that exist between the equatorial jungle environment and the arctic tundra environment.

2. To increase student awareness that each environment requires plants and animals to adapt both physically and behaviorally if they are to survive successfully.

The requirements for the environmental section and plant life pertaining to the rain forest of this activity can be approached in one of two ways:

1. Students may be asked to refer back to notes taken during the introductory activities on the tropics before their trip to the zoo.

or

2. This portion of the activity may be handled as a review activity involving the whole class with emphasis on the basic characteristics of the tropics.

The information on the tundra environment and its plant life is all available in the tundra exhibit and should be recorded on the student data sheet "The Other Extreme."

The animals of both environments [with the exception of *the great horned owl, see notes below] are all on display at the zoo, and the information concerning them should be recorded on the two student data sheets "The Other Extreme" and " Mammals of the Tropics."

Because students who are not experienced at data collecting have a tendency to focus on and record different things, it may be beneficial to have yours work in small groups of two or three to complete those portions of this activity that come from zoo exhibits. This way each child can have the extra advantage of someone else's observations as well as his own.

* *Bubo virginianus* [the great horned owl] is found in the Northwest but whose range extends to the southern tip of South America. Students of this region may be familiar with this typical large noctural hunter, with brown and white plumage making it difficult to see. It hunts in the canopy and feeds on small nocturnal mammals.

Living Around The World

Using your data sheet, " Mammals of the Tropics", fill in the following chart with the **scientific names** of the animals, to show which continent they live on.

	continent	monkeys	apes	cats	others
Old World	**AFRICA**				
Old World	**ASIA**				
New World	**SOUTH AMERICA**				

Looking at the above chart, what can you conclude about:

1. where apes are found? _____
2. rain forest cats? _____
3. tropical bears? _____
4. new world monkeys? _____
5. primates in general? _____

Teacher's Guide to " Living Around the World"

The general characteristics of the rain forest are the same, regardless of which continent it is found on. The way animals have adapted to them varies from one continent to another. An example of this is the monkeys of South America which have developed prehensile tails, while those of Africa and Asia have not. Rain forest animals also demonstrate what biologists call "parallel or convergent evolution" where two unrelated species of animals develop to the point that they resemble each other because they are filling the same niche, [doing the same job].

The student objectives for this activity are to:

1. Give students practice sorting data and categorizing it by specific criteria.
2. Give students practice drawing conclusions based on data collected.
3. Introduce the concept of scientific names and their implications.

By using the data collected on the student data sheet, "Mammals of the Tropics," students can sort the Washington Park Zoo tropical mammals into groups based on continents. They may then use this breakdown to draw some conclusions concerning the similarities and/or differences that exist among groups from continent to continent.

Start by having students fill in the chart, "Living Around the World" using "Mammals of the Tropics" as their source of information. "Living Around the World" specifically asks students to sort the animals by their scientific name. If students feel more comfortable using the common name as well, they most certainly may do so, but not as a sole alternative.

Once this sheet is completely filled out, discuss the idea of relationship between groups of animals and point out to students that just because animals appear similar to one another does not mean they are closely related. Explain how we can use the scientific name of the animal to draw a conclusion regarding relationship. Scientific names are composed of two words; the first the animal's genus, the second the animal's species. Animals belonging to the same species are all of the same type. Animals belonging to the same genus are more closely related than animals belonging to different genera.

You may wish to use an animal such as the jaguar [*Panthera onca*] as an example, indicating they all belong to the species *onca*, which says to us they are as a group reproductively compatable or able to mate and produce viable offspring. Students can draw the conclusion from the information given in the name that the jaguar is more closely related to the leopard, which also belongs to the *Panthera* genus, but living in Africa and Asia, than the other cats which belong to the genus *Felis*. It also indicates to us that even if they did live on the same continent, "in the wild" they would not reproduce.

With older students this can be extended to discussion about how we classify living things, why we classify them, which taxonomic groups we use [kingdom-species], why we have scientific names and why those names are Latinized.